MONTHLY NOTICES

OF THE

ROYAL ASTRONOMICAL SOCIETY.

VOL. LXXIV. SUPPLEMENTARY NUMBER. NO. 9

*The Proper Motions of the Stars in Carrington's Circumpolar Catalogue in relation to their Spectral Types.* By F. W. Dyson, M.A., LL.D., F.R.S., Astronomer Royal.

1. The proper motions of these stars have been determined by comparison of the positions observed by Carrington with those observed at Greenwich forty-five years later. The probable error of the proper motion in one co-ordinate may be taken as $1''\cdot00$ per century. The stars all lie within 9° of the North Pole, and go down to the limit of magnitude of the Bonn Durchmusterung.

Thanks to the courtesy of Messrs. Müller and Kron, who are determining the visual magnitudes of these stars, I have been furnished in manuscript with the visual magnitudes of about three-quarters of them. By comparison with the photographic magnitudes, which have been determined at Greenwich, stars are arranged into groups according to their colour. The differences Greenwich Photographic Magnitudes–Potsdam Visual Magnitudes differ from the true colour indices of the stars by about $0^m\cdot35$ owing to the different scales of magnitude used. I have not investigated the differences in detail, but have compared the differences of photographic and visual magnitudes with the spectral types given in Harvard Circular 180, using only stars fainter than $7^m\cdot0$ visual. The relation between the difference photographic–visual magnitude and the type of spectrum given in the Harvard Circular is approximately :—

| Phot.-Vis. Mag. | Type of Spectrum. |
|---|---|
| $< -\cdot4^m$ | $B_8 - A_2$ |
| $-\cdot3^m$ to $-\cdot1^m$ | $A_5 - F_0$ |
| $-\cdot1^m$ to $+\cdot4^m$ | $F_5 - G_5$ |
| $+\cdot4^m$ to $+\cdot75^m$ | $G_5 - K_0$ |
| $+\cdot75^m$ to $1\cdot0^m$ | $K_0 - K_5$ |
| $>1\cdot0^m$ | $K_5 - M$ |

2. The stars were grouped into classes according to colour differences $>1^m{\cdot}0$, $0^m{\cdot}9$ to $1^m{\cdot}0$, etc., indicated by the numerals $>10$, 9, 8, etc. They were at the same time sorted according to visual magnitudes. A relationship between the magnitude of proper motion and colour was very clearly shown. Considering the group of stars fainter than $9^m{\cdot}5$ on the Potsdam scale, it is found, for example, that

(1) *Colour difference* $>10$ ($K_5$ *to* $M$).—Out of 132 stars, only 6 have total proper motions $>5''{\cdot}0$ a century. These are only slightly greater, being $6''{\cdot}1$; $6''{\cdot}1$; $5''{\cdot}9$; $5''{\cdot}7$; $5''{\cdot}7$; $5''{\cdot}6$.

(2) *Colour difference* $<-4$ ($B_8$ *to* $A_2$).—Out of 101 stars, 11 have total proper motions $>5''{\cdot}0$ a century, ranging from $5''{\cdot}1$ to $8''{\cdot}1$ a century.

(3) *Colour difference* $+3$ ($G_0$ *to* $G_5$).—Out of 164 stars, 37 have total proper motions $>5''{\cdot}0$ a century. These include $33''{\cdot}2$, $21''{\cdot}6$, 4 from $10''$ to $11''$ a century, 11 from $8''{\cdot}0$ to $10''{\cdot}0$ a century.

In the following table the percentage of different classes of stars with the total proper motions $>5''{\cdot}0$ a century is given :—

| Colour Difference. | | Stars fainter than $9^m{\cdot}5$. | | Magnitude $8^m{\cdot}0$ to $9^m{\cdot}5$. | | Stars brighter than $8^m{\cdot}0$. | |
|---|---|---|---|---|---|---|---|
| | | No. | % | No. | % | No. | % |
| $K_5-M$ | $>10$ | 132 | 5 | 80 | 2 | 33 | 30 |
| $K_2$ | 8, 9 | 137 | 8 | 51 | 8 | 13 | 23 |
| $K_0$ to $G_5$ | 7·5 | 86 | 12 | 32 | 25 | 11 | 36 |
| | 6·5 | 108 | 11 | 43 | 12 | 14 | 43 |
| | 5·5 | 125 | 14 | 29 | 17 | 7 | 29 |
| | 4·5 | 109 | 20 | 29 | 27 | 9 | 89 |
| $G_5$ to $F_5$ | 3·5 | 164 | 23 | 37 | 38 | 8 | 88 |
| | 2·5 | 160 | 23 | 26 | 35 | 9 | 44 |
| | 1·5 | 196 | 21 | 37 | 43 | 11 | 65 |
| | 0·5 | 213 | 24 | 44 | 43 | 9 | 78 |
| | −0·5 | 226 | 23 | 63 | 40 | 11 | 91 |
| $F_0$ to $A_0$ | −1·5 | 140 | 21 | 49 | 25 | 13 | 31 |
| | −2·5 | 131 | 21 | 60 | 13 | 12 | 25 |
| | −3·5 | 84 | 18 | 37 | 13 | 7 | 29 |
| | $<-4$ | 101 | 11 | 47 | 9 | 17 | 12 |

The most striking feature of this table is the small number of red stars with proper motions greater than $5''{\cdot}0$ a century. Next to these come the A stars and those from $G_5$ to K. The stars with largest proper motions are those whose type of spectrum is F to G.

3. The proper motions were resolved in the directions of the solar motion and its perpendicular. Near the pole it happens

that the direction of the solar motion coincides with the streaming or preferential motion of the stars. In the following tables are given the algebraic and arithmetic means of the centennial proper motions in the two directions.

*Stars fainter than* $9^m \cdot 5$ (*Visual Potsdam Scale*).

| Colour Difference. | Number of Stars. | Apical Proper Motion. | | Cross Proper Motion. | | Omitted. |
|---|---|---|---|---|---|---|
| | | " | " | " | " | |
| >10 | 132 | −·58 | ±1·50 | −·26 | ±1·33 | 0 |
| 8 to 10 | 137 | −·15 | ±1·37 | −·20 | ±1·39 | 0 |
| 7·5 | 86 | −·71 | ±1·94 | −·17 | ±1·10 | 2 |
| 6·5 | 108 | −·77 | ±1·94 | −·19 | ±1·33 | 2 |
| 5·5 | 125 | −1·19 | ±1·93 | −·12 | ±1·66 | 1 |
| 4·5 | 109 | −1·12 | ±2·35 | −·05 | ±1·95 | 1 |
| 3·5 | 164 | −1·54 | ±2·66 | −·23 | ±1·91 | 2 |
| 2·5 | 160 | −1·66 | ±2·69 | −·12 | ±1·99 | 0 |
| 1·5 | 196 | −1·48 | ±2·88 | −·21 | ±1·97 | 3 |
| 0·5 | 213 | −1·25 | ±2·94 | −·12 | ±1·63 | 2 |
| −0·5 | 226 | −1·75 | ±2·98 | −·30 | ±1·88 | 1 |
| −1·5 | 143 | −1·47 | ±2·53 | −·39 | ±1·61 | 0 |
| −2·5 | 135 | −1·04 | ±2·56 | −·28 | ±1·51 | 0 |
| −3·5 | 84 | −1·11 | ±2·44 | −·30 | ±1·55 | 0 |
| <−4 | 100 | −1·15 | ±2·07 | −·15 | ±1·50 | 0 |

*Stars from* $8^m \cdot 0 - 9^m \cdot 5$ (*Visual Potsdam Scale*).

| | | " | " | " | " | |
|---|---|---|---|---|---|---|
| >10 | 80 | −·02 | ±1·41 | −·27 | ±1·04 | 1 |
| 8−10 | 51 | −·42 | ±1·73 | +·08 | ±1·34 | 1 |
| 7·5 | 31 | −1·44 | ±2·61 | +·16 | ±1·62 | 0 |
| 6·5 | 43 | −1·49 | ±2·37 | −·12 | ±1·42 | 1 |
| 5·5 | 29 | −0·65 | ±2·02 | −·66 | ±1·52 | 1 |
| 4·5 | 29 | −1·23 | ±2·06 | +·41 | ±1·77 | 0 |
| 3·5 | 37 | −3·10 | ±4·22 | −·20 | ±1·79 | 3 |
| 2·5 | 26 | −3·63 | ±3·98 | −·49 | ±2·16 | 0 |
| 1·5 | 37 | −3·28 | ±4·02 | +·01 | ±1·52 | 3 |
| 0·5 | 44 | −2·13 | ±5·40 | −·58 | ±3·13 | 0 |
| −0·5 | 67 | −1·79 | ±3·71 | +·07 | ±2·19 | 0 |
| −1·5 | 49 | −1·63 | ±2·81 | −·42 | ±1·79 | 0 |
| −2·5 | 60 | −1·37 | ±2·36 | −·45 | ±1·30 | 0 |
| −3·5 | 37 | −1·52 | ±2·15 | −·93 | ±1·40 | 0 |
| <−4 | 47 | −1·73 | ±2·28 | −·00 | ±1·03 | 0 |

Stars with proper motion $>20''$ a century are omitted.

4. With regard to these figures it may be noted that if the probable error of a proper motion is $\pm 1''{\cdot}0$ a century, the mean error is $\pm 1''{\cdot}18$, and this is hardly exceeded in the cross proper motions of the red stars which are brighter than $9^m{\cdot}5$. It is not possible to draw any conclusions about the cross proper motions of these stars, except that they are very small. It may be assumed that for stars fainter than $9^m{\cdot}5$ there is a somewhat larger mean error, possibly as much as $\pm 1''{\cdot}30$, corresponding to a probable error of $\pm 1''{\cdot}10$.

5. Taking first the stars at the red end. For 400 stars fainter than $8^m{\cdot}0$ with colour differences $>8$ the parallactic motion is $0''{\cdot}30$ a century, corresponding to a parallax of $''{\cdot}0009$.

6. The mean parallactic motions of the remaining stars are as follows:—

| Types of Spectrum. | Col. Diff. | Mean Mag. | P.ms. $>20''$ Included. | P.ms. $>20''$ Excluded. | Mean Mag. | P.ms. $>20''$ Included. | P.ms. $>20''$ Excluded. |
|---|---|---|---|---|---|---|---|
| | | m | ″ | ″ | m | ″ | ″ |
| $G_5-K_0$ | +6 | 10·22 | ·95 | ·95 | 8·79 | 1·69 | 1·21 |
| $F_5-G_5$ | +1·5 | 10·32 | 1·64 | +1·53 | 8·84 | 3·34 | 2·61 |
| $A_0-F_0$ | −3 | 10·29 | 1·28 | +1·28 | 8·83 | 1·55 | 1·55 |

The inclusion or exclusion of the large proper motions makes a considerable difference in the mean parallactic motion of the stars of magnitude $8^m{\cdot}0-9^m{\cdot}5$, as their proper motions happen to be almost entirely parallactic and the total number of stars in the different classes is small. There is always a difficulty in knowing how to deal with these cases which is only met when the distribution is taken into account. Taking the mean of the two determinations, and dividing by $412''$ sin $55°$, the mean parallaxes of these different classes are:

| | Mag. | Parallax. | Mag. | Parallax. |
|---|---|---|---|---|
| | | ″ | | ″ |
| $G_5-K_0$ | 10·2 | ·0028 | 8·8 | ·0043 |
| $F_5-G_5$ | 10·3 | ·0047 | 8·8 | ·0078 |
| $A_0-F_0$ | 10·3 | ·0038 | 8·8 | ·0046 |

The most interesting feature about these numbers is that the diminution of parallax in passing from magnitude $8^m{\cdot}8$ to $10^m{\cdot}3$ is small for the $A_0$ to $F_0$ stars, but changes for the $F_5$ to $G_5$ group.

7. The mean values of the cross motions (excluding stars with p.m. $>20''$ a century) are as follows:—

| Type. | Mag. | Cross Motion. | Mag. | Cross Motion. |
|---|---|---|---|---|
| | m | ″ | m | ″ |
| $G_5-K_0$ | 10·22 | ±1·54 | 8·79 | ±1·66 |
| $F_5-G_5$ | 10·32 | ±1·87 | 8·84 | ±2·20 |
| $A_0-F_0$ | 10·29 | ±1·55 | 8·83 | ±1·38 |

For the brighter stars the probable error is taken as $\pm 1''{\cdot}00$, and for the fainter stars as $\pm 1''{\cdot}10$, corresponding to mean errors of

$\pm 1''\cdot18$ and $\pm 1''\cdot30$. Making allowance for these, the corrected cross motions compared with the parallactic motions are as follows:—

| Type. | Mag. | Parall. p.m. | Cross p.m. | Mag. | Parall. p.m. | Cross p.m. |
|---|---|---|---|---|---|---|
| $G_5 - K_0$ | 10·22 | ″·95 | ± ″·82 | 8·79 | 1″·21 | ±1″·17 |
| $F_5 - G_5$ | 10·32 | 1·53 | ±1·34 | 8·84 | 2·11 | ±1·86 |
| $A_0 - F_0$ | 10·29 | 1·28 | ± ·84 | 8·83 | 1·55 | ±0·71 |

The results for the cross velocities are not very accordant. For the $G_5 - K_0$ stars they give 14·1 km./sec. for the stars of magnitude 10·2, and 15·4 km./sec. for the stars of magnitude 8·8; for the $F_5 - G_5$ stars 14·0 km./sec. and 11·4 km./sec.; for the $A_0 - F_0$ stars 10·5 km./sec. and 7·4 km./sec.

8. The stars whose colour indices (as defined by the differences between the Potsdam visual and the Greenwich photographic magnitudes) lie between $-1$ and $+4$ have been examined in greater detail. These stars will be referred to as the F to G stars. Arranging them in three groups according to the Potsdam visual magnitude, the following table is found:—

| Magnitude. | Number. | Parallactic Motion. | Mean Observed. | Cross Motion Corrected. |
|---|---|---|---|---|
| | | ″ | ″ | ″ |
| <9·0 | 148 | 3·34 | ±3·13 | ±2·90 |
| 9·0 – 10·0 | 312 | 2·08 | ±2·09 | ±1·72 |
| 10·0 – 11·0 | 777 | 1·55 | ±1·91 | ±1·40 |

The last column is derived from the last but one by allowing for a probable error of $\pm 1''\cdot00$ a century for the stars brighter than $10^m\cdot0$ and $\pm 1''\cdot10$ for the stars $10^m\cdot0 - 11^m\cdot0$. These correspond to mean errors of $\pm 1''\cdot18$ and $1''\cdot30$. Combining the results so as to include all stars brighter than certain limits of magnitude, the following table is obtained:—

| Magnitude. | Number. | M. | $a$. |
|---|---|---|---|
| < 9·0 | 148 | 3·34 | ±2·90 |
| <10·0 | 460 | 2·50 | 2·10 |
| <11·0 | 1237 | 1·92 | 1·67 |

In the above table M denotes the mean parallactic motion, and $a$ the corrected mean cross motion. The magnitudes are, as has been stated, the Potsdam visual magnitudes. In the last group all the stars are included, some being fainter than $11^m\cdot0$. It may be judged from the numbers that the limiting magnitude is not far from 11·0, though it is not accurately determined.

9. In the *Monthly Notices* for March 1913 it was found that, taking all the Carrington stars, the number with cross proper motion $<\tau$ was satisfied by the formula $N\frac{\tau}{\sqrt{\tau^2 + a^2}}$, where $a$ is

the mean value of the cross proper motion. I have assumed that the same formula holds for the F – G stars when the group of stars taken includes all down to $9^{m}\cdot0$, $10^{m}\cdot0$, or $11^{m}\cdot0$.

10. It is necessary before comparing the numbers given by the formula with the observed numbers to make allowance for the effect of accidental error. If the probable error be taken as $\frac{\cdot477}{h}$, Professor Eddington has given the formula

$$u(\tau) = \exp.\left(\frac{1}{4h^2}\frac{d^2}{d\tau^2}\right)v(\tau),$$

connecting the true number $v(\tau)$ with the observed number $u(\tau)$. Putting $v(\tau) = \frac{N\tau}{\sqrt{\tau^2+a^2}}$, this gives satisfactory results for moderately large values of $\tau$.

11. I have found the following formula for the apparent number of cross motions between 0 and $\tau$ when the true number is $N\frac{\tau}{\sqrt{a^2+\tau^2}}$:—

$$u(\tau) = Nh\tau\{k_0 - k_1h^2\tau^2 + k_2\frac{1}{2!}(h^2\tau^2)^2\text{—etc.}\}$$

when $$k_n = \frac{2}{\sqrt{\pi}}\int_0^{\frac{\pi}{2}} \sin^{2n}\theta\cos\theta\exp.(-a^2h^2\tan^2\theta)d\theta.$$

This is a convergent series, and $1 > k_0 > k_1 > k_2$, etc., $> 0$, the successive terms, are connected by the equation

$$(2n+3)k_{n+1} = 2(2n+1+a^2h^2)k_n - (2n-1)k_{n-1}.$$

12. By calculating these integrals, I have found the value of $u(\tau)$ for values of $\tau$ less than $5''$, and by using Eddington's formula for values of $\tau > 5''$: the two calculations agreeing for $\tau = 5''$. A comparison of the theoretical distribution on the assumption that $\frac{\cdot477}{h} = 1''$ with that observed is shown in the following table:—

| Limits of p.m. | Stars brighter than $9^{m}\cdot0$. $a = 2''\cdot90$. | | Stars brighter than $10^{m}\cdot0$. $a = 2''\cdot1$. | | Stars brighter than $11^{m}\cdot0$. $a = 1''\cdot67$. | |
|---|---|---|---|---|---|---|
| | Calculated. | Observed. | Calculated. | Observed. | Calculated. | Observed. |
| $0''-1''$ | 39 | 42 | 143 | 147 | 441 | 440 |
| 1 – 2 | 33 | 30 | 107 | 120 | 346 | 354 |
| 2 – 4 | 42 | 34 | 135 | 116 | 341 | 332 |
| 4 – 7 | 20 | 27 | 50 | 47 | 108 | 107 |
| 7 – 10 | 8 | 9 | 11 | 15 | 23 | 26 |
| > 10 | 6 | 6 | 10 | 11 | 19 | 19 |

The agreement is satisfactory, and the distribution of the cross proper motions may therefore be taken as given by the formula $N\frac{a^2 d\tau}{(\tau^2+a^2)^{\frac{3}{2}}}$; the number of stars N, the mean cross motion $a$, and the parallactic motion M being as follows:—

| Mag. | N. | M. | $a$. | $a/M$. |
|---|---|---|---|---|
| $< 9{\cdot}0$ | 148 | $3''{\cdot}34$ | $\pm 2''{\cdot}90$ | ·87 |
| $<10$ | 460 | $2{\cdot}50$ | $\pm 2{\cdot}10$ | ·84 |
| $<11$ | 1237 | $1{\cdot}92$ | $\pm 1{\cdot}67$ | ·87 |

13. If V be the Sun's linear velocity, the mean cross velocity of these stars $= {\cdot}86\text{V} \cos 35°$, and taking $\text{V} = 19{\cdot}5$ km./sec., the mean cross velocity $= 13{\cdot}7$ km./sec.

14. It is now assumed that the linear velocities of the stars in the direction perpendicular to the solar motion are distributed according to the error law. Out of the total N the number which have velocities between $u$ and $u+du$ is $N\frac{h}{\sqrt{\pi}}e^{-h^2u^2}du$, where $\frac{1}{h\sqrt{\pi}} = 13{\cdot}7$ km./sec. In combination with the observed distribution of cross proper motions $\left(\text{that the number between } \tau \text{ and } \tau+d\tau = \frac{Na^2 d\tau}{(\tau^2+a^2)^{\frac{3}{2}}}\right)$ it follows that the number of stars between the distances $r$ and $r+dr$ is $N2a^2h^2re^{-a^2h^2r^2}dr$.

15. The velocity 13·7 km./sec. is equal to $291''$ a century at a distance of 1 parsec.

Thus $\frac{1}{h\sqrt{\pi}} = \frac{291}{206265}$ parsecs per century.

$a = 2''{\cdot}90$ gives $\frac{1}{ah} = 180$ parsecs, and $ah = {\cdot}00558$.

$a = 2''{\cdot}10$ ,, $\frac{1}{ah} = 240$ ,, ,, $ah = {\cdot}00418$.

$a = 1''{\cdot}67$ ,, $\frac{1}{ah} = 312$ ,, ,, $ah = {\cdot}00320$.

The number of stars brighter than $9^{\text{m}}{\cdot}0$ between the distances $r$ and $r+dr$

$$= 148 \times 2 \times ({\cdot}00558)^2 r dr \exp.\ (-{\cdot}00558^2 r^2),$$

and the number nearer than $r$

$$= 148\{1 - \exp.\ (-{\cdot}00558^2 r^2)\}.$$

The number of stars brighter than $10^{\text{m}}{\cdot}0$ between the distances $r$ and $r+dr$

$$= 460 \times 2({\cdot}00418)^2 r dr \exp.\ (-{\cdot}00418^2 r^2),$$

and the number nearer than $r$

$$= 460\{1 - \text{exp.}\ (-\cdot00418^2 r^2)\}.$$

The number of stars brighter than $11^{m}\cdot0$ between the distances $r$ and $r+dr$

$$= 1247 \times 2\ (\cdot00320)^2 r dr\ \text{exp.}\ (-\cdot00320^2 r^2),$$

and the number nearer than $r$

$$= 1247\{1 - \text{exp.}\ (-\cdot00320^2 r^2)\}.$$

16. Numerical results calculated from these formulæ are given in the following table:—

*Number of Solar Stars (types F and G) at Different Distances.*

| Distance. | 1247 Stars brighter than $11^{m}\cdot0$. | 460 Stars brighter than $10^{m}\cdot0$. | 148 Stars brighter than $9^{m}\cdot0$. | 787 Stars $10^{m}\cdot0 - 11^{m}\cdot0$. | 312 Stars $9^{m}\cdot0 - 10^{m}\cdot0$. |
|---|---|---|---|---|---|
| < 100 parsecs. | 121 | 74 | 40 | 47 | 34 |
| 100 – 200 | 298 | 158 | 65 | 140 | 93 |
| 200 – 300 | 332 | 133 | 34 | 199 | 99 |
| 300 – 400 | 254 | 67 | 8 | 187 | 59 |
| 400 – 500 | 146 | 23 | 1 | 123 | 22 |
| 500 – 600 | 65 | 5 | ... | 60 | 5 |
| 600 – 700 | 23 | ... | ... | 23 | ... |
| 700 – 800 | 6 | ... | ... | 6 | ... |
| 800 | 2 | ... | ... | 2 | ... |

The mean parallax of the $10^{m}\cdot0$ to $11^{m}\cdot0$ stars $= ''\cdot0047$, and of the $9^{m}\cdot0$ to $10^{m}\cdot0$ stars $= ''\cdot0066$, while the mean distances are 315 and 230 parsecs respectively. The close limits of distance within which the majority of the stars lie is clearly shown in the table. Of the stars from $10^{m}\cdot0 - 11^{m}\cdot0$, 83 per cent. lie between the distances of 100 and 500 parsecs, and of the $9^{m}\cdot0 - 10^{m}\cdot0$ stars 80 per cent. between the distances of 100 and 400 parsecs. Of the stars brighter than $9^{m}\cdot0$, 94 per cent. are nearer the Sun than 300 parsecs.

17. In considering the luminosity of the stars, those between magnitudes $10\cdot0 - 11\cdot0$ have all been treated as though they were of the same magnitude $10\cdot5$, and those between the magnitudes $9\cdot0 - 10\cdot0$ as though they were all of the same magnitude $9\cdot5$. It is then very simple to find the number of stars of different luminosities. It is convenient to divide the space occupied by the stars into a series of spheres whose radii are in geometrical progression, the logarithm of the common ratio being $\cdot1$.

From the formulæ of § 15 the number of stars brighter than

$9^{m}\cdot0$, brighter than $10^{m}\cdot0$, and brighter than $11^{m}\cdot0$ at distances greater than $r$ given in the first column of the following table are calculated, and the differences give the stars from $10^{m}\cdot0 - 11^{m}\cdot0$ and $9^{m}\cdot0 - 10^{m}\cdot0$.

*Number of Stars beyond Certain Limits of Distance.*

| Distance in parsecs = $r$. | log $r$. | Number of Stars. | | | Number of Stars. | |
|---|---|---|---|---|---|---|
| | | $<11^{m}\cdot0$ | $<10^{m}\cdot0$ | $<9^{m}\cdot0$ | $10^{m}\cdot0 - 11^{m}\cdot0$ | $9^{m}\cdot0 - 10^{m}\cdot0$ |
| 32 | 1·5 | 1235 | 452 | 144 | 783 | 308 |
| 40 | 1·6 | 1227 | 447 | 141 | 780 | 306 |
| 50 | 1·7 | 1215 | 440 | 137 | 775 | 303 |
| 63 | 1·8 | 1197 | 429 | 131 | 768 | 298 |
| 79 | 1·9 | 1169 | 412 | 122 | 757 | 290 |
| 100 | 2·0 | 1126 | 386 | 108 | 740 | 278 |
| 126 | 2·1 | 1060 | 349 | 90 | 711 | 259 |
| 159 | 2·2 | 964 | 297 | 68 | 667 | 229 |
| 200 | 2·3 | 830 | 229 | 43 | 601 | 186 |
| 252 | 2·4 | 654 | 153 | 21 | 501 | 132 |
| 316 | 2·5 | 448 | 80 | 7 | 368 | 73 |
| 398 | 2·6 | 246 | 27 | 1 | 219 | 26 |
| 501 | 2·7 | 76 | 6 | 0 | 70 | 6 |
| 631 | 2·8 | 21 | 0 | ... | 21 | 0 |
| 795 | 2·9 | 2 | ... | ... | 2 | 0 |
| 1000 | 3·0 | 0 | ... | ... | 0 | 0 |
| Total number | | 1247 | 460 | 148 | 787 | 312 |

18. Subtracting successive rows of the last two columns, the number of what will be treated as $10^{m}\cdot5$ and $9^{m}\cdot5$ stars which lie within certain limits of distance are found. These limits of distance correspond to a change of half a magnitude, and if the absolute magnitude of the Sun be taken as $10^{m}\cdot5$ (on the Potsdam scale) at a distance of 100 parsecs, it follows that, of the stars of apparent magnitude 10·5, 29 lie between the Sun and half a magnitude brighter in absolute luminosity, 44 between half a magnitude and 1 magnitude brighter than the Sun, etc. Of the $9^{m}\cdot5$ stars 19 are similarly between 1 and $1\frac{1}{2}$ magnitudes brighter than the Sun, 30 between $1\frac{1}{2}$ and 2 magnitudes brighter, and so on. The numbers are given in the following table, in which the intrinsic magnitudes are compared with the Sun :—

*Absolute Luminosities of* $10^m{\cdot}5$ *and* $9^m{\cdot}5$ *Stars.*

| Limits of Distance. | Stars of App. Mag. 10·5. | Stars of App. Mag. 9·5. |
|---|---|---|
| < 32 | 12 more than $2^m{\cdot}5$ fainter | 4 more than $1^m{\cdot}5$ fainter |
| | m m | m m |
| 32 – 40 | 3 from 2·0 – 2·5 ,, | 2 ,, 1·0 – 1·5 ,, |
| 40 – 50 | 5 ,, 1·5 – 2·0 ,, | 3 ,, 0·5 – 1·0 ,, |
| 50 – 63 | 7 ,, 1·0 – 1·5 ,, | 5 ,, 0·0 – 0·5 ,, |
| 63 – 79 | 11 ,, 0·5 – 1·0 ,, | 8 ,, 0·0 – 0·5 brighter |
| 79 – 100 | 17 ,, 0·0 – 0·5 ,, | 12 ,, 0·5 – 1·0 ,, |
| 100 – 126 | 29 ,, 0·0 – 0·5 brighter | 19 ,, 1·0 – 1·5 ,, |
| 126 – 159 | 44 ,, 0·5 – 1·0 ,, | 30 ,, 1·5 – 2·0 ,, |
| 159 – 200 | 66 ,, 1·0 – 1·5 ,, | 43 ,, 2·0 – 2·5 ,, |
| 200 – 252 | 100 ,, 1·5 – 2·0 ,, | 54 ,, 2·5 – 3·0 ,, |
| 252 – 316 | 133 ,, 2·0 – 2·5 ,, | 59 ,, 3·0 – 3·5 ,, |
| 316 – 398 | 149 ,, 2·5 – 3·0 ,, | 47 ,, 3·5 – 4·0 ,, |
| 398 – 501 | 149 ,, 3·0 – 3·5 ,, | 20 ,, 4·0 – 4·5 ,, |
| 501 – 631 | 49 ,, 3·5 – 4·0 ,, | 6 ,, 4·5 – 5·0 ,, |
| 631 – 795 | 19 ,, 4·0 – 4·5 ,, | ... |
| 795 – 1000 | 2 ,, 4·5 – 5·0 ,, | ... |

Of the 787 stars of apparent magnitude 10·0 – 11·0, 531 are between $1^m{\cdot}5$ and $3^m{\cdot}5$ brighter than the Sun, *i.e.* between 4 and 25 times as luminous; and of the 312 stars between 9·0 and 10·0, 203 are between $2^m{\cdot}0$ and $4^m{\cdot}0$ brighter than the Sun, *i.e.* between 6 and 40 times as luminous. None of the stars are 100 times as luminous as the Sun, and only 12 out of 787 are less than $\frac{1}{10}$ as luminous.

19. For the density in space of the stars of different luminosity as the parts of the sky dealt with extends from N.P.D. 5° to N.P.D. 9°, it includes approximately $\frac{1}{200}$ of the whole sphere. The volume included between 100 and 126 parsecs is $\frac{4}{3}\ (100)^3\ \frac{1}{200}$ approximately, or taking $\frac{4}{3}\pi(100)^3$ as the unit, the volume is $\frac{1}{200}$. The volume between 126 and 159 parsecs is approximately twice this, or accurately $\frac{1}{200}10^{0\cdot3}$. The number of stars of different luminosities compared with the Sun is given in the following table:—

| Mean Distance. | Number of Stars in Unit Volume $\frac{4}{3}\pi(100)^3$. | | | |
|---|---|---|---|---|
| | Stars of App. Mag. $10^m \cdot 5$. | | Stars of App. Mag. $9^m \cdot 5$. | |
| | m m | | m m | |
| 37 | 2·0 – 2·5 fainter | 19,000 | 13,000 | 1·0 – 1·5 fainter |
| 47 | 1·5 – 2·0 ,, | 16,000 | 11,000 | 0·5 – 1·0 ,, |
| 59 | 1·0 – 1·5 ,, | 11,000 | 8,000 | 0·0 – 0·5 ,, |
| 74 | 0·5 – 1·0 ,, | 8,800 | 6,400 | 0·0 – 0·5 brighter |
| 93 | 0·0 – 0·5 ,, | 6,800 | 4,800 | 0·5 – 1·0 ,, |
| 118 | 0·0 – 0·5 brighter | 5,800 | 3,800 | 1·0 – 1·5 ,, |
| 148 | 0·5 – 1·0 ,, | 4,400 | 3,000 | 1·5 – 2·0 ,, |
| 186 | 1·0 – 1·5 ,, | 3,300 | 2,100 | 2·0 – 2·5 ,, |
| 234 | 1·5 – 2·0 ,, | 2,500 | 1,350 | 2·5 – 3·0 ,, |
| 295 | 2·0 – 2·5 ,, | 1,660 | 740 | 3·0 – 3·5 ,, |
| 372 | 2·5 – 3·0 ,, | 930 | 300 | 3·5 – 4·0 ,, |
| 468 | 3·0 – 3·5 ,, | 460 | 62 | 4·0 – 4·5 ,, |
| 589 | 3·5 – 4·0 ,, | 78 | 10 | 4·5 – 5·0 ,, |
| 741 | 4·0 – 4·5 ,, | 15 | ... | |
| 933 | 4·5 – 5·0 ,, | 1 | ... | |

20. The figures are arranged so that by comparing a line in the left-hand column with one two lines above it in the right-hand column the density in different parts in space may be compared. In going from 589 to 933 parsecs the density has diminished tenfold, judging from the stars, which are $4^m \cdot 5 - 5^m \cdot 0$ brighter than the Sun. Between 372 and 589 parsecs it has diminished in the ratio 300 : 78 or 4 : 1. From 295 to 468 the diminution is in the ratio 740 : 460 or 1·6 : 1. For distances $< 100$ parsecs little reliance is to be put on the figures, both because the figures are small and because the formulæ cannot apply near the origin. Taking the density at 93 parsecs as unity that at 148 is ·92, and taking the density at 118 (by interpolation) as ·96 the densities are found to be as follows:—

| Distance. | Star Density. |
|---|---|
| 93 parsecs | 1·00 |
| 118 | ·96 |
| 148 | ·92 |
| 186 | ·84 |
| 234 | ·78 |
| 295 | ·66 |
| 372 | ·54 |
| 468 | ·41 |
| 589 | ·13 |
| 741 | ·10 |

The figures obtained by Kapteyn (Eddington, "Stellar Movements and the Structure of the Universe") in a different manner and from different data are:—

| Distance. | Star Density. |
|---|---|
| 0 parsecs | 1·00 |
| 50 | ·99 |
| 135 | ·86 |
| 213 | ·67 |
| 540 | ·30 |
| 850 | ·15 |

The agreement is fairly satisfactory.

21. Making allowance for this diminution of density, the proportion of stars of different luminosities at 79–100 parsecs from the Sun is as follows:—

| Luminosity. | No. in Unit Volume. |
|---|---|
| m m 0·0 – 0·5 fainter than Sun | 6800 |
| 0·0 – 0·5 brighter than Sun | 6000 |
| 0·5 – 1·0 ,, | 4800 |
| 1·0 – 1·5 ,, | 3940 |
| 1·5 – 2·0 ,, | 3200 |
| 2·0 – 2·5 ,, | 2500 |
| 2·5 – 3·0 ,, | 1700 |
| 3·0 – 3·5 ,, | 1100 |
| 3·5 – 4·0 ,, | 600 |
| 4·0 – 4·5 ,, | 150 |
| 4·5 – 5·0 ,, | 77 |

These figures are only approximate, but may be taken to give a general indication of the luminosity and density laws for the stars of types F and G.

*Royal Observatory, Greenwich:*
1914 *June* 22.

LIST OF ADDITIONS

# TO THE LIBRARY

OF THE SOCIETY

JUNE 1913 TO JUNE 1914.

*An asterisk (*) indicates that the work is an excerpt.*

Abbadia, Observatoire:

——: Observations faites au cercle méridien en 1912. Tome 12. Publiées par A. Verschaffel.
(*Observatory.*) 4to. Hendaye, 1913

——: Tables pour le calcul de la Précession en A.R. et D. Équinoxe de 1900.
(*Observatory*). 4to. Hendaye, 1913

Acta Mathematica. Zeitschrift, herausgegeben von G. Mittag-Leffler. Band 37, pt. 1–3; Table Générale, Tome 1–35.
(*Purchased.*) 4to. Stockholm, 1913–1914

Algiers, Observatoire:

——: Catalogue Photographique du Ciel. Tome 4 (Appendice), Tome 5, 6, 7.
(*French Minister of Public Instruction.*) 4to. Paris, 1913

Tome 4 (App.) Tables pour la transformation des coordonnées rectilignes en coordonnées sphériques, par M. Pourteaux.
,, 5, 6, 7. Coordonnées rectilignes.

——: Carte photographique du Ciel. Thirty-eight charts. Zone $+3^\circ$, $+1^\circ$, $-1^\circ$.
(*French Minister of Public Instruction.*)

Allegheny Observatory:

Publications. Vol. 3, No. 4–8.
(*Observatory.*) 4to. Lancaster, Pa., 1913–1914

American Academy of Arts and Sciences: *see* Boston.

American Journal of Mathematics. Edited by Frank Morley. Published under the auspices of the Johns Hopkins University. Vol. 35, No. 3, 4; Vol. 36, No. 1, 2.
(*Editors.*) 4to. Baltimore, 1913–1914

American Journal of Science. Editor E. S. Dana [and others]. Fourth series, Vol. 36, 37 (No. 210-222).
(*Editors.*) 8vo. New Haven, 1913–1914

Amsterdam, Koninklijke Akademie van Wetenschappen:
——: Verslagen van de gewone Vergaderingen der Wis- en Natuurkundige Afdeeling, 1912–1913. Deel 21, pt. 1, 2.
(*Academy.*) 8vo. Amsterdam, 1912–1913
——: Proceedings of the section of Sciences, Vol. 15, pt. 1 and 2.
(*Academy.*) 8vo. Amsterdam, 1912–1913
——: Verhandelingen (Eerste Sectie), Deel 11, No. 5, 6.
(*Academy.*) 8vo. Amsterdam, 1912–1913
——: Jaarboek, 1912.
(*Academy.*) 8vo. Amsterdam, 1913

Antwerp, Société d'Astronomie:
Neuvième Rapport, 1913.
(*Society.*) 8vo. Anvers, 1914

Arcetri, Reale Osservatorio:
Pubblicazioni del R. Istituto di studi superiori pratici e di perfezionamento, fasc. 31.
(*Observatory.*) 4to. Firenze, 1913
A. Abetti. Osservazioni astronomiche fatte . . . 1912.

Astronomical Herald (the). Published by the Astronomical Society of Japan [in Japanese]. Vol. 6, No. 1–11.
(*Society.*) 4to. 1913–1914

Astronomical Journal. Founded by B. A. Gould. Vol. 27, 28 (No. 648–667).
(*Editor.*) 4to. Boston, 1913–1914

Astronomie (L'.) *See* Paris, Société Astronomique de France.

Astronomische Mitteilungen. Gegründet von Rudolf Wolf: herausgegeben von A. Wolfer. No. 104.
(*Editor.*) 8vo. Zürich, 1914

Astronomische Nachrichten. Begründet von H. C. Schumacher: herausgegeben von H. Kobold. Band 195–198 (No. 4659–4738).
(*Editor.*) 4to. Kiel, 1913–1914
——: Literarisches Beiblatt zu den Astronomischen Nachrichten. No. 11–21.
(*Editor.*) 4to. Kiel, 1913–1914
(*Another Copy purchased.*)

Astronomischer Jahresbericht. Begründet von W. F. Wislicenus. . . . Bearbeitet im Kgl. Astronomischen Rechen-Institut zu Berlin. Band 14. Die Literatur des Jahres, 1912.
(*K. Astron. Rechen-Institut, Berlin.*) 8vo. Berlin, 1913

**Astrophysical Journal (the).** An International Review of spectroscopy and astronomical physics. Edited by G. E. Hale [and others]. Vol. 37, No. 5–Vol. 39, No. 4.
(*Editors.*) 8vo. Chicago, 1913–1914
(*Another Copy purchased.*)

**Athenæum (the).** Journal of English and foreign literature, science, the fine arts, music, and the drama, 1913–1914 (No. 4469–4520).
(*Editor.*) 4to. London, 1913–1914

**Auwers (G. F. J. Arthur):**
Bearbeitung der Bradley'schen Beobachtungen an den alten Meridianinstrumenten der Greenwicher Sternwarte. Band 2: die Beobachtungen am Graham'schen Quadranten 1743–1758.
(*Prof. Auwers.*) 4to. Leipzig, 1913

**Babbage (Charles):**
Reflections on the decline of science in England, and on some of its causes.
(*Lady Gill.*) 8vo. London, 1830

**Bamberg, Remeis-Sternwarte:**
Veröffentlichungen . . . herausgegeben vom Direktor Ernst Hartwig. Reihe II. (Astrophysikalische Abteilung). Band 1, Heft. 2. 4to. Bamberg, 1913
E. Hartwig, Beobachtungen Veränderlicher Sterne.

**Barcelona, Sociedad Astronomica:**
Boletin, Año 4, 5. (No. 31–41.)
(*Society.*) 8vo. Barcelona, 1913–1914

**Basel, Naturforschende Gesellschaft:**
Verhandlungen; Band 24.
(*Society.*) 8vo. Basel, 1913

**Batavia, Koninklijke Natuurkundige Vereeniging in Nederlandsch-Indië:**
Natuurkundig Tijdschrift voor Nederlandsch-Indië. Deel 72.
(*Society.*) 8vo. Weltevreden, 1913

**Batavia, Royal Magnetical and Meteorological Observatory:**
Observations . . . published by order of the Government of Netherlands India. Vol. 33.
(*Observatory.*) 4to. Batavia, 1913

**Belfast Natural History and Philosophical Society:**
Report and Proceedings . . . for the session 1911–1912.
(*Society.*) 8vo. Belfast, 1912

**Berlin, Deutsche physikalische Gesellschaft:**
—— : Die Fortschritte der Physik im Jahre 1912. Jahrgang 68, dritte Abteilung, enthaltend kosmische Physik, redigirt von Richard Assmann.
(*Society.*) 8vo. Braunschweig, 1913

Berlin, Deutsche physikalische Gesellschaft—*continued*:
——: Verhandlungen, Jahrgang 15, Heft 9–24; Jahrg. 16, Heft 1, 2.
(*Society.*) 8vo. Berlin, 1913–1914

Berlin, Königlich Astronomisches Rechen-Institut:
——: Berliner Astronomisches Jahrbuch für 1915; mit Angaben für die Oppositionen der Planeten (1)–(732) für 1913, herausgegeben . . . unter Leitung von Fritz Cohn.
(*Institute.*) 8vo. Berlin, 1913
——: Berliner Astronomisches Jahrbuch für 1916; mit Angaben für die Oppositionen der Planeten (1)–(754) für 1914.
(*Institute.*) 8vo. Berlin, 1914

Berlin, Königlich Preussische Akademie der Wissenschaften:
——: Abhandlungen: Physikalisch-mathematische Classe. Jahrgang 1912; 1913, No. 1; 1914, No. 1.
(*Academy.*) 4to. Berlin, 1912–1914
——: Sitzungsberichte, 1913, No. 23–53; 1914, No. 1–18.
(*Academy.*) 8vo. Berlin, 1913–1914

Berlin, Königliche Sternwarte:
Beobachtungs Ergebnisse, Heft 15.
(*Observatory.*) 4to. Berlin, 1913
L. Courvoisier; Systematische Abweichungen der Sternpositionen.

Berlin, Vereinigung von Freunden der Astronomie und kosmischen Physik:
Mitteilungen, Jahrgang 23, Heft 5–11; Jahrgang 24, Heft 1–3.
(*Purchased.*) 8vo. Berlin, 1913–1914

Bessel (Friedrich Wilhelm) und Karl August Steinheil:
Briefwechsel . . . herausgegeben im Auftrage der Königlichen Akademien der Wissenschaften zu Berlin und München.
(*Purchased.*) 8vo. Leipzig und Berlin, 1913

Birkeland (Kr.):
The Norwegian Aurora Polaris Expedition, 1902–1903. On the cause of magnetic storms and the origin of terrestrial magnetism.
(*Author.*) 2 vols. 4to. Christiania [1913]

Bologna, Reale Accademia delle Scienze dell' Istituto:
——: Memorie, Sezione delle scienze fisiche e matematiche, Serie 6, Tomo 9.
(*Academy.*) 4to. Bologna, 1912
——: Rendiconto della sessione 1911–1912. Nuova Serie, Vol. 16.
(*Academy.*) 8vo. Bologna, 1912

Bombay and Alibag Observatory:
——: Report of the Director for 1913.
(*Observatory.*) fol. Bombay and Alibag, 1914

Bombay and Alibag Observatory—*continued*:

——: Magnetical, meteorological, and seismological observations made . . . in the years 1906–1919.
(*Observatory.*) 4to. Bombay, 1913

Bonn, Königliche Sternwarte:

Veröffentlichungen, No. 12.
(*Observatory.*) 4to. Bonn, 1914

H. Giebeler. Der Sternhaufen Messier 37.

Bordeaux Observatoire:

Carte photographique du Ciel. Seventeen charts. Zone + 16°, + 14°, + 12°.
(*French Minister of Public Instruction.*)

Bordeaux, Société des Sciences Physiques et Naturelles:

Procès-verbaux des séances, année 1911–1912.
(*Society.*) 8vo. Paris et Bordeaux, 1912

Boston, American Academy of Arts and Sciences:

——: Memoirs. Vol. 14, No. 1.
(*Academy.*) 4to. Cambridge, Mass., 1913

——: Proceedings. Vol. 48, No. 18–21; Vol. 49, No. 1–9, 11.
(*Academy.*) 8vo. Boston, Mass., 1913–1914

Brahe (Tycho):

Tychonis Brahe Dani Opera Omnia, edidit I. L. E. Dreyer. Tomus 1.
(*Editor.*) 4to. Hauniæ, 1913

Brown's Nautical Almanac, Harbour and dock guide, and daily tide tables for 1914.
(*Editor.*) 8vo. Glasgow [1913]

Brussels, Académie Royale des Sciences, des Lettres et des Beaux-Arts de Belgique:

——: Bulletin de la classe des sciences; 1913, No. 3–12; 1914, No. 1–4.
(*Academy.*) 8vo. Bruxelles, 1913–1914

——: Classe des Sciences: Mémoires (Collection in 8vo). Tome 3, fasc. 7, 8.
(*Academy.*) 8vo. Bruxelles, 1914

——: Annuaire, année 80 (1914).
(*Academy.*) 8vo. Bruxelles, 1914

Brussels, Société Belge d'Astronomie:

Ciel et Terre: Bulletin de la Société Belge d'Astronomie, et Revue populaire d'astronomie, de météorologie et de physique du globe. Année 34, No. 5–12; Année 35, No. 1–4.
(*Society.*) 8vo. Bruxelles, 1913–1914

Budapest, Magyar Tudományos Akadémia:

——: Rapport sur les travaux de l'Académie hongroise des Sciences en 1912.
(*Academy.*) 8vo. Budapest, 1913

Budapest, Magyar Tudományos Akadémia—*continued:*
——: Mathematische und naturwissenschaftliche Berichte aus Ungarn. Band 26, Heft 4; Band 27, 28, 29 (1908–1911).
(*Academy.*) 8vo. Leipzig, 1913

Bulletin Astronomique. Fondé en 1884 par E. Mouchez et F. Tisserand. Publié par l'Observatoire de Paris. Tome 30, No. 6–12; Tome 31, No. 1–5.
(*Purchased.*) 8vo. Paris, 1913–1914

Bulletin des Sciences Mathématiques. Rédigé par G. Darboux et É. Picard. Série 2. Tome 37, No. 6–12; Tome 38, No. 1–5.
(*Editors.*) 8vo. Paris, 1913–1914

Burnham, Sherburne Wesley:
Measures of Proper Motion Stars made with the 40-inch Refractor of the Yerkes Observatory in the years 1907 to 1912.
(*Carnegie Institution.*) 4to. Washington, 1913

Calcutta, Astronomical Society of India:
Journal, Vol. 3, No. 6–9; Vol. 4, No. 1–5.
(*Society.*) 8vo. Calcutta, 1913–1914

Cambridge Observatory:
Annual Report of the Observatory Syndicate, 1912–1913.
(*Observatory.*) 4to. Cambridge [1913]

Cambridge Philosophical Society:
——: Proceedings, Vol. 17, pt. 3–5.
(*Society.*) 8vo. Cambridge, 1913–1914
——: Transactions, Vol. 22, pt. 2–4.
(*Society.*) 4to. Cambridge, 1913–1914

Campbell (William Wallace):
Stellar Motions; with special reference to motions determined by means of the Spectrograph.
(*Purchased.*) 8vo. New Haven, 1913
(*Another Copy presented by Author.*)

Canada, Royal Society:
Proceedings and Transactions. Third series, Vol. 6.
(*Society.*) 8vo. Ottawa, 1913

Cape of Good Hope, Royal Observatory:
——: Annals, Vol. 8, pt. 3; Vol. 10, pt. 4.
(*Observatory.*) 4to, London, 1912–1913
Vol. 8, pt. 3. Observations of Major Planets.
,, 10, ,, 4. Spectroscopic Researches.
——: Cape Astrographic Zones. Vol. 1.
(*Observatory.*) 4to. London, 1913
Catalogue of rectangular co-ordinates and diameters of star images. . . . Zone −41°.

Cape of Good Hope, Royal Observatory—*continued*:
——: Independent day numbers for the year 1915.
(*Observatory.*) 8vo. London, 1913
——: Report of H.M. Astronomer . . . for the years 1912, 1913.
(*Observatory.*) 4to. London, 1913–1914

Cape Town, Royal Society of South Africa:
Transactions, Vol. 3, pt. 2; Vol. 4, pt. 1.
(*Society.*) 8vo. Cape Town, 1913–1914

Cape Town, South African Association for the Advancement of Science:
The South African Journal of Science, Vol. 9, No. 11–13; Vol. 10, No. 1–8.
(*Association.*) 8vo. Cape Town, 1913–1914

Cardiff, Astronomical Society of Wales:
Journal, 1912.
(*Society.*) 16mo. Cardiff [1913]

Catania, Reale Osservatorio:
Catalogo Astrofotografico, 1900·0; Zona di Catania, fra le declinazioni + 46° e + 55°. Vol. 4, pt. 1.
(*Observatory.*) 4to. Catania, 1913

Catania, Società degli Spettroscopisti Italiani:
Memorie . . . Fondata da P. Tacchini: pubblicazione mensile continuata per cura di A. Riccò. Serie 2, Vol. 2, Disp. 5–12; Vol. 3, Disp. 1–4.
(*Society.*) 4to. Catania, 1913–1914

Chatham, Royal Engineers' Institute:
The Royal Engineers' Journal, Vol. 18, 19.
(*Institute.*) 8vo. Chatham, 1913–1914

Chevalier (S.):
*Étude photographique de la Photosphère Solaire.
(*Author.*) 4to. Chang-Hai, 1912

Chicago, Society for Practical Astronomy:
The Monthly Register, Vol. 5, No. 4–8; Vol. 6, No. 1–3.
(*The Editor.*) 8vo. Chicago, 1913–1914

Ciel et Terre. *See* Brussels, Société Belge d'Astronomie.

Copenhagen, Kongelige Danske Videnskabernes Selskab:
——: Oversigt over det K. Danske Videnskabernes Selskabs Forhandlinger. 1913, No. 3–6; 1914, No. 1.
(*Society.*) 8vo. Kjöbenhavn, 1913–1914
——: Skrifter, naturvidensk. og mathematisk Afd.: 7te Række, Bd. 10, No. 3, 4; Bd. 11, No. 1.
(*Society.*) 4to. Kjöbenhavn, 1913

Copenhagen, Observatorium:
*Publikationer og mindre Meddelelser. No. 13–19.
(*Observatory.*) 8vo & 4to. Kjöbenhavn & Kiel, 1913–1914

Cordoba, Observatorio Nacional Argentino:
Durchmusterung [new edition]. Maps 4–8.
(*Observatory.*)

Crommelin (Andrew C. de la C.):
The Star World.
(*Author.*) 12mo. London & Glasgow [1914]

Dublin, Royal Irish Academy:
Proceedings (third series), Section A, Vol. 32, No. 1.
(*Academy.*) 8vo. Dublin, 1913

Dublin, Royal Society:
Scientific Proceedings. New series. Vol. 13, No. 38, 39; Vol. 14, No. 1–16.
(*Society.*) 8vo. Dublin, 1913–1914

Edinburgh Royal Observatory:
Twenty-fourth annual report of the Astronomer Royal for Scotland, 1913–1914.
(*Observatory.*) 8vo. Edinburgh, 1914

Edinburgh, Royal Society:
——: Proceedings. Vol. 33, pt. 2–4; Vol. 34, pt. 1.
(*Society.*) 8vo. Edinburgh, 1913–1914
——: Transactions, Vol. 48, pt. 3, 4; Vol. 49, pt. 1, 2.
(*Society.*) 4to. Edinburgh, 1912–1913

Egypt, Survey Department:
Survey Department Papers, No. 18.
(*Director-General.*) 8vo. Cairo, 1913
P. A. Curry. The value of Gravity at eight stations in Egypt and the Sudan.

English Mechanic and World of Science (the). Vol. 97–99 (No. 2517–2563).
(*Editor.*) fol. London, 1913–1914

Euler (Leonhard):
Opera Omnia; sub auspiciis Societatis Scientiarum naturalium Helveticae edenda curaverunt F. Rudio, A. Krazer, P. Stäckel. Series I., Opera Mathematica, Vol. 10, 11, 12, 21.
(*Purchased.*) 4to. Lipsiae et Berolini, 1913–1914

Europe, Centralbureau der Internationalen Erdmessung:
——: Verhandlungen der . . . siebzehnten allgemeinen Conferenz . . . . Teil I.
(*The Bureau.*) 4to. Berlin, 1913
——: Rapport sur les travaux du Bureau Central pendant les 50 premières années de l'Association Géodésique Internationale, par F. R. Helmert.
(*The Bureau.*) 4to. Leyde, 1913

Flammarion (Camille):
Annuaire Astronomique et Météorologique pour 1914.
(*Editor.*) 8vo. Paris [1913]

Franz (Julius):
*Die Randlandschaften des Mondes.
(*Breslau Observatory.*) 4to. Halle, 1913

Fritsche (H.):
Die Bestimmung der Elemente des Erdmagnetismus und ihrer zeitlichen Aenderungen. [Lithographed MS.]
(*Author.*) 8vo. Riga, 1913

Gautier (Raoul):
Rapport sur le Concours de réglage de chronomètres, 1912.
(*Author.*) 8vo. Genève, 1913

Geneva, Société de physique et d'histoire naturelle:
——: Mémoires, Tome 37, fasc. 4; Tome 38, fasc. 1.
(*Society.*) 4to. Genève, 1913–1914
——: Comptes rendus des séances, 30, 1913.
(*Society.*) 8vo. Genève, 1914

Genoa, Istituto Idrografico:
——: Annali Idrografici: raccolta di documenti e notizie circa l'Idrografia e la Navigazione. Vol. 8, 1911–1912.
(*Institute.*) 4to. Genova, 1913
——: Tavole Logaritmiche a cinque cifre decimali.
(*Institute.*) 4to. Genova, 1913

Gill (Sir David):
A history and description of the Royal Observatory, Cape of Good Hope.
(*Astronomer Royal.*) fol. London, 1913

Ginzel (Friedrich Karl):
Handbuch der mathematischen und technischen Chronologie: das Zeitrechnungswesen der Völker. Band 3.
(*Purchased.*) 8vo. Leipzig, 1914

Göttingen, Königliche Gesellschaft der Wissenschaften:
Nachrichten, mathematisch-physikalische Klasse. 1913, Heft 1–4.
(*Society.*) 8vo. Göttingen, 1913

Göttingen, Königliche Sternwarte:
Astronomische Mitteilungen, Teil 16.
(*Observatory.*) 4to. Göttingen, 1913
O. Kohl. Untersuchungen über den ultravioletten Teil einiger Fixsternspektren.

Granada, Observatorio Astronomico, Geodinamico y Meteorológico:
——: *Bulletin de l'activité solaire, 1912 Sept.–Déc.; 1913 Jan.–Mar.
(*Observatory.*) 8vo. Bruxelles, 1913
——: *L'activité solaire pendant l'Année 1912.
(*Observatory.*) 8vo. Bruxelles, 1913

Greenwich, Royal Observatory:

——: Astronomical and magnetical and meteorological observations made . . . in the years 1911, 1912, under the direction of F. W. Dyson.
(*Observatory.*) 4to. London, 1913

——: Appendices:
Results of Astronomical Observations, 1911, 1912.
Results of Magnetical and Meteorological Observations, 1911.
Photoheliographic results, 1911, 1912.
Altazimuth Catalogue.
Position of the Sun's Axis, as determined from photographs . . . 1875 to 1912.
Photographic magnitudes of stars brighter than $9^{m}\cdot0$, between Declination $+75°$ and the pole.
Report of the Astronomer Royal to the Board of Visitors, 1913.
(*Observatory.*) 4to. London, 1912–1913

Hagen (Johann Georg):
Die veränderlichen Sterne. Band 1, Geschichtlich-technicher Teil: Lieferung 1.
(*Purchased.*) 4to. Freiburg im Breisgau, 1913
Die Ausrüstung des Beobachters.

Halle, Kaiserliche Leopoldinisch Carolinische Akademie der Naturforscher:

——: Abhandlungen (Nova Acta). Band 98, 99.
(*Academy.*) 4to. Halle, 1913

——: Leopoldina . . . herausgegeben von Dr. A. Wangerin. Heft 49. Jahrgang 1913.
(*Academy.*) 4to Halle, 1913

Hamburger Sternwarte in Bergedorf:

——: Astronomische Abhandlungen, Band 3, No. 1.
(*Observatory.*) 4to. Hamburg, 1913
R. Schorr. Die Hamburgische Sonnenfinsternis-Expedition . . . 1905 Aug. Teil II.

——: Mitteilungen. No. 12, 13.
(*Observatory.*) 8vo. Hamburg, 1913

——: Totale Sonnenfinsternis 1905 August 30: Photographische Aufnahmen der Sonnenkorona, ausgeführt in Souk-Ahras (Algerien), von R. Schorr.
(*Observatory.*) fol. Hamburg, 1912

——: Jahresbericht, für das Jahr 1912.
(*Observatory.*) 8vo. Hamburg, 1913

Hart (Henry):
Easy paths to the Stars (Indian Edition). A guide to the Constellations, with a series of Star Maps for all the year round, and explanatory notes for finding the Stars.
(*Author.*) 4to. Allahabad, 1913

Hartwig (Ernst):
*Katalog und Ephemeriden veränderlicher Sterne für 1914.
(*Author.*) 8vo. Leipzig, 1913

**Harvard College Astronomical Observatory:**
—— : Annals, Vol. 76, No. 1 ; Vol. 78, pt. 1.
(*Observatory.*) 4to. Cambridge, Mass., 1913
Vol. 76, No. 1. E. S. King. Absorbing medium in space.
,, 78, pt. 1. S. I. Bailey. Variable Stars in Cluster M. 3.
—— : Circular, No. 178–182.
(*Observatory.*) 4to. Cambridge, Mass., 1913–1914
—— : Sixty-eighth annual report of the Director . . . 1913. By E. C. Pickering.
(*Observatory.*) 8vo. Cambridge, Mass., 1914

**Hawkins (Hester Periam):**
The A.B.C. Guide to astronomy. Second edition.
(*Lady Gill.*) 8vo. London & Bedford

**Hawks (Ellison):**
Stars shown to the children.
(*Author.*) 12mo. London & Edinburgh [1912]

**Hayford (John F.):**
A text-book of Geodetic Astronomy.
(*Purchased.*) 8vo. New York, 1910

**Heidelberg (Königstuhl), Grossherzogliche Sternwarte:**
Veröffentlichungen . . . herausgegeben von Max Wolf. Band 6, No. 8–11 ; Band 7, No. 1–4.
(*Observatory.*) 4to. Karlsruhe, 1913

**Helsingfors, Finska Vetenskaps-Societet:**
—— : Öfversigt af Finska Vetenskaps-Societetens Förhandlinger. 55 (1912–1913) C.
(*Society.*) 8vo. Helsingfors, 1913
—— : Acta Societatis Scientiarum Fennicæ. Tomus 38, No. 2 ; 41, No. 9 ; 42, No. 4 ; 43, No. 2, 3 ; 44, No. 1, 2, 4, 6 ; 45, No. 1.
(*Society.*) 4to. Helsingforsiae, 1913–1914

**Helwân, Khedivial Observatory:**
Bulletin, No. 10, 11.
(*Observatory.*) 8vo. 1913–1914

**Henderson (Alexander Colin):**
Astronomy Simplified.
(*Author.*) 8vo. London, 1913

**Himmel und Erde.** Illustrierte naturwissenschaftliche Monatsschrift, herausgegeben von der Gesellschaft Urania ; Redigiert von P. Schwahn. Jahrgang 25, Heft 9–12 ; Jahrgang 26, Heft 1–8.
(*Editor.*) 8vo. Berlin, 1913–1914

**Hobart, Royal Society of Tasmania:**
Papers and Proceedings, 1913.
(*Society.*) 8vo. Hobart [1914]

Horological Journal (the). Vol. 55, 56 (No. 659–670).
(*Brit. Horol. Institute.*) 8vo. London, 1913–1914

Housden (C. E.):
The riddle of Mars the Planet.
(*Author.*) 8vo. London, 1914

Hübner (Erich):
*Beitrag zur Theorie der isostatischen Reduktion der Schwerebeschleunigung.
(*K. preuss. Geodät. Inst.*) 8vo. Leipzig, 1913

India, Astronomical Society: *see* Calcutta.

India, Survey Department:
——: General report on the operations of the Survey of India Department . . . during 1911–1912.
(*H.M. Govt. in India.*) fol. Calcutta, 1913
——: Records of the Survey of India. Vol. 3, 1911–12.
(*H.M. Govt. in India.*) fol. Calcutta, 1913
——: Professional Papers. No. 14.
(*H.M. Govt. in India.*) 4to. Dehra Dun, 1913
J. de G. Hunter. Formulæ for atmospheric refraction.

International Catalogue of Scientific Literature:
E. (Astronomy), 11th annual issue (1911–1912).
C. (Physics), 11th annual issue (1911–1912).
(*Purchased.*) 8vo. London, 1913

Jarry-Desloges (R.):
Observations des surfaces planétaires: Mars, Saturne, la Lune, Vénus, Mercure. Fasc. 3. 1911–1912.
(*M. Jarry-Desloges.*) 4to. Paris, 1913

Johannesburg, Union Observatory:
Circular, No. 6–16.
(*Observatory.*) 4to. Pretoria, 1913–1914

Journal Astronomique: [publié par l'Observatoire de l'Université de Lille]. Tome 2, No. 28.
(*Editor.*) 4to. Lille, 1913

Kasan, Observatoire Astronomique de l'Université Impériale.
Publications, No. 15, 24.
(*Observatory.*) 4to. Kasan, 1913–1914
No. 15. Mouvement propre de 721 étoiles.
,, 24. Catalogue de 721 étoiles.

Kasan, Université Imperiale; Observatoire Engelhardt:
Publication, No. 6, 7.
(*Observatory.*) 4to. Kasan, 1913
V. Baranoff. 2me Catalogue de 120 étoiles variables.

Kiel, Sternwarte der K. Christian-Albrechts-Universität:
Astronomische Beobachtungen. No. 2, 3.
(*Observatory.*) 4to. Leipzig, 1912

No. 2. P. Harzer. Untersuchungen über die Teilungen der Kreise des Repsold-Meridiankreise.
,, 3. P. Harzer. Untersuchungen über die Teilungen der Hilfsbögen.

Knowledge. New Series. Vol. 10, No. 7–12; Vol. 11, No. 1–6.
(*Editor.*) 4to. London, 1913–1914

Kodaikánal and Madras Observatories:
——: Bulletin, No. 31–36.
(*Observatory.*) 4to. Madras, 1913
——: Annual Report of the Director for 1913.
(*Observatory.*) fol. Madras, 1914

Kostinsky (S.):
*Observations photographiques des satellites de Mars faites en 1909.
(*Author.*) 4to. St. Pétersbourg, 1914

Kugler (Franz Xaver):
Sternkunde und Sterndienst in Babel. Ergänzungen zum I. und II. Buch. Teil 1, Abhandl. 1–8.
(*Purchased.*) 8vo. Münster, 1913

Leeds Astronomical Society:
Journal and Transactions, No. 20 (1912).
(*Society.*) 8vo. Leeds, 1913

Leiden (Sterrenwacht):
Verslag van den Staat der Sterrenwacht te Leiden . . . 1910–1912.
(*Observatory.*) 8vo. Leiden, 1913

Leipzig, Astronomische Gesellschaft:
Vierteljahrsschrift, Jahrgang 48, Heft 1–4; 49, Heft 1.
(*Society.*) 8vo. Leipzig, 1913–1914

Leipzig, Fürstlich Jablonowski'sche Gesellschaft:
Jahresbericht, 1912.
(*Society.*) 8vo. Leipzig, 1913

Leipzig, Königlich Sächsische Gesellschaft der Wissenschaften:
——: Abhandlungen, mathematisch-physische Classe. Band 32, No. 7.
(*Society.*) 8vo. Leipzig, 1913
——: Berichte über die Verhandlungen: mathematisch-physische Classe. Band 64, Heft 4–7; Band 65, Heft 1–3.
(*Society.*) 8vo. Leipzig, 1912–1913

Lick Observatory, University of California:
Bulletin, No. 228–254.
(*Observatory.*) 4to. 1913–1914

London, Board of Education:
Reports for the year 1912 on the Geological Survey, the Geological Museum . . ., the Science Museum . . ., and the work of the Solar Physics Committee.
(*Science Museum.*) 8vo. London, 1913

London, British Astronomical Association:
——: Journal, Vol. 23, No. 8–10; Vol. 24, No. 1–7.
(*Association.*) 8vo. London, 1913–1914
——: Memoirs, Vol. 19, pt. 3, 4.
(*Association.*) 8vo. London, 1913–1914
——: Memoirs: Appendix to Vols. 15 and 18: Sixth and seventh reports of the section for the observation of variable Stars. [Light curves of 21 variable Stars.]
(*Col. Markwick and Mr. C. L. Brook.*) 8vo. London, 1913
——: List of members, 1913.
(*Association.*) 8vo. London, 1913

London, Meteorological Office:
The Geophysical Journal, 1912, No. 9–12, and Supplement; 1913, No. 1–5.
(*Meteorological Office.*) 4to. London, 1913–1914

London, Nautical Almanac and Astronomical Ephemeris for the meridian of the Royal Observatory, Greenwich, 1916.
(*Lords Commissioners of Admiralty.*) 8vo. London, 1914
——: Nautical Almanac Circular, No. 20.
(*Lords Commissioners of Admiralty.*) 8vo. London, 1914
Local particulars of the total eclipse of the Sun, August 20–21, 1914.

London, Physical Society:
Proceedings, Vol. 25, pt. 4–6; Vol. 26, pt. 1–3.
(*Society.*) 8vo. London, 1913–1914

London, Royal Astronomical Society:
——: Monthly Notices, Vol. 74. 8vo. London, 1913–1914
——: Memoirs, Vol. 60, pt. 3, 4. 8vo, London, 1913–1914

London, Royal Institution of Great Britain:
Proceedings, Vol. 20, pt. 1 (No. 105).
(*Institution.*) 8vo. London, 1913

London, Royal Photographic Society:
The Photographic Journal; including the Transactions of the Royal Photographic Society, Vol. 53, No. 6–8; Vol. 54, No. 1–5.
(*Society.*) 8vo. London, 1913–1914

London, Royal Society:
—— : Philosophical Transactions, Series A, Vol. 213, 214 (No. 499–513).
(*Society.*) 4to. London, 1913–1914
—— : Proceedings, Series A, Vol. 88, 89 (No. 605–618).
(*Society.*) 8vo. London, 1913–1914
—— : Year-book, 1914.
(*Society.*) 8vo. London, 1914
—— : Provisional Reports [of meetings], 1913 Nov. 6–1914 June 25.
(*Society.*) 8vo. [London, 1913–1914]
—— : The celebration of the two hundred and fiftieth Anniversary of the Royal Society of London, July 15–19, 1912.
(*Society.*) 4to. London, 1913
—— : Catalogue of the Periodical Publications in the Library of the Royal Society of London.
(*Society.*) 8vo. London, 1912

London University College:
Calendar, session 1913–1914.
(*The College.*) 8vo. London, 1913

Lowell Observatory:
Bulletin, No. 57–61.
(*Percival Lowell.*) 4to. 1913–1914

Lunar Nomenclature Committee of the International Association of Academies:
Collated list of Lunar Formations named or lettered in the maps of Neison, Schmidt, and Mädler. . . . By Mary A. Blagg, under the direction of the late S. A. Saunder.
(*Prof. Turner.*) 8vo. Edinburgh, 1913

Lund, Astronomiska Observatorium:
—— : *Meddelanden . . . No. 55–60.
(*Observatory.*) 8vo. Uppsala & Stockholm, 1913–1914
—— : *Meddelanden . . . Serie 2, No. 10, 11.
(*Observatory.*) 4to. Lund, 1913–1914
No. 10. H. Henie. Distribution of the stars to the 11th magnitude.
„ 11. O. A. Åkesson. Motion and distribution of Sun-spots.

Madrid, Observatorio Astronómico:
Anuario, año 1914.
(*Observatory.*) 8vo. Madrid, 1913

Madrid, Real Academia de Ciencias exactas, físicas y naturales:
—— : Memorias, Tomo 15, Suplemento.
(*Academy.*) 4to. Madrid, 1913
—— : Revista . . . Tomo 11, No. 5–12; Tomo 12, No. 1–7.
(*Academy.*) 8vo. Madrid, 1913–1914
—— : Anuario, 1914.
(*Academy.*) 16mo. Madrid

Manchester Literary and Philosophical Society:
Memoirs and Proceedings, Vol. 57, pt. 2, 3; Vol. 58, pt. 1.
(*Society.*) 8vo. Manchester, 1913–1914

Maunder (Edward Walter):
——: Sir William Huggins and Spectroscopic Astronomy.
(*Author.*) 8vo. London & Edinburgh [1913]
——: *Early Astronomy [report of lecture].
(*Author.*) 8vo. 1913

Maupertuis (Pierre Louis Moreau de):
Discours sur la parallaxe de la Lune, pour perfectionner la théorie de la Lune et celle de la Terre.
(*Major Hills.*) 8vo. Paris, 1741

Mauritius, Royal Alfred Observatory:
——: Results of the Magnetical and Meteorological Observations made . . . in the years 1907, 1909.
(*Observatory.*) 4to. Mauritius, 1912–1913
——: Annual Report of the Director . . . for 1912.
(*Observatory.*) fol. Mauritius, 1913

Mayher (W.):
Die Astronomische Zeitrechnung der Völker von ihrem Ursprung bis zur Gegenwart und die Einheitszeit.
(*Purchased.*) 4to. München, 1913

Meudon, Observatoire Physique de Paris:
Annales . . . publiées par H. Deslandres. Tome 5, fasc. 1.
(*Observatory.*) 4to. Paris, 1912

Milan, Reale Osservatorio di Brera:
Pubblicazioni, No. 51.
(*Observatory.*) 4to. Milano, 1914
L. Volta e G. Forni. Latitudine del R. Osservatorio di Brera.

Missouri University, Laws Observatory:
Bulletin, Astronomical Series. No. 20, 21.
(*Observatory.*) 4to. 1913

Montpellier, Académie des Sciences et Lettres:
——: Bulletin mensuel, 1913, No. 6–12; 1914, No. 1–5.
(*Academy.*) 8vo. Montpellier, 1913–1914
——: Mémoires de la section des Sciences, 2me série, Tome 4, No. 4.
(*Academy.*) 8vo. Montpellier, 1912

Moscow, Gesellschaft von Freunden der Astronomie:
Die totale Sonnenfinsternis vom 21 August 1914, im Europäischen Russland [Russian and German].
(*The Society.*) fol. Moskau, 1913

Mount Wilson, California, Solar Observatory:
——: Contributions . . . No. 69–81.
(*Carnegie Institution.*) 8vo. Chicago, 1913–1914
——: Annual Report of the Director . . . 1913.
(*Carnegie Institution.*) 8vo. Washington [1914]

Moustapha (Ismail):
Recherche des coefficients de dilatation et étalonnage de l'appareil à mesurer les bases géodésiques appartenant au gouvernement égyptien.
(*Lady Gill.*) 8vo. Paris, 1864

Munich, Königlich-bayerische Akademie der Wissenschaften:
——: Abhandlungen der mathematisch-physikalischen Classe. Band 26, Abt. 7–10. Supplement Band 2, Abt. 10; Supp. Band 3, Abt. 2; Supp. Band 4, Abt. 3.
(*Academy.*) 4to. München, 1913–1914
——: Register zu den Abhandlungen, Denkschriften und Reden der . . . Akademie . . . 1807–1913.
(*Academy.*) 8vo. München, 1914
——: Sitzungsberichte der mathematisch-physikalischen Classe. Jahrgang 1913, Heft 3.
(*Academy.*) 8vo. München, 1913

Naples, Società Reale (R. Accademia delle Scienze):
Rendiconto dell' Accademia delle scienze fisiche e matematiche. Serie 3: Vol. 19, fasc. 1–5.
(*Academy.*) 8vo. Napoli, 1913

National Physical Laboratory:
——: Collected researches. Vol. 9, 10.
(*Laboratory.*) 4to. 1913
——: Report of the year 1912.
(*Laboratory.*) 8vo. Teddington, 1913

Nature. A weekly illustrated journal of science. Vol. 91, 92, 93 (No. 2277–2323).
(*Editor.*) 4to. London, 1913–1914

Neuchatel, Observatoire Cantonal:
Rapport du Directeur . . . pour l'année 1912, 1913.
(*Observatory.*) 8vo. Neuchatel, 1913–1914

Neugebauer (Paul V.):
Tafeln für Sonne, Planeten und Mond, nebst Tafeln der Mondphasen für die Zeit 4000 vor Chr. bis 3000 nach Chr. (Tafeln zur astronomischen Chronologie II.).
(*Purchased.*) 8vo. Leipzig, 1914

Observatory (the). A monthly review of astronomy; edited by F. J. M. Stratton, A. S. Eddington and S. Chapman. Vol. 36, 37 (No. 463–475).
(*Editors.*) 8vo. London, 1913–1914

**Olsen (Ole Theodor):**
The Fisherman's Nautical Almanac and Tide Tables. 38th year, 1914.
(*Author.*) 8vo. Grimsby, 1913

**Oporto, Academia Polytechnica:**
Annaes Scientificos. Vol. 8, No. 2–4; Vol. 9, No. 1.
(*Academy.*) 8vo. Coimbra, 1913–1914

**Orchard (Thomas N.):**
Milton's Astronomy: the Astronomy of "Paradise Lost."
(*Author.*) 8vo. London, 1913

**Ottawa. Dominion Astronomical Observatory:**
Publications. Vol. 1, No. 1–5.
(*Observatory.*) 4to. Ottawa, 1913

**Oxford, Radcliffe Observatory:**
Results of meteorological observations, 1913. Vol. 51, pt. 3.
(*Radcliffe Trustees.*) 8vo. Oxford, 1914

**Oxford, University Observatory:**
——: 39th Annual Report of the Savilian Professor of Astronomy.
(*Observatory.*) 8vo. Oxford, 1914
——: Astrographic Catalogue, 1900·0. Oxford Section. Vol. 8, pt. 1.
(*Observatory.*) 4to. London, 1913
Corrections to the places of the Cambridge (Astr. Gesell.) Catalogue, deduced from Oxford photographic measures.
——: Miscellaneous Papers . . . edited by H. H. Turner. Vol. 4, 1910–1914 (Nos. 175–228).
(*Observatory.*) 8vo. Oxford, 1914

**Palermo, Reale Osservatorio:**
——: Pubblicazioni . . . Memorie. No. 14–31.
(*Observatory.*) 8vo. Palermo, 1905–1913
——: Dante e l'almanacco di Profazio Giudeo. G. R. D'Orsogna.
(*Observatory.*) 8vo. Palermo, 1909

**Palisa (Johann) und Max Wolf:**
Photographische Sternkarten (Æquin. 1875·0). Serie VIII. [20 Charts.]
(*Purchased.*) Wien

**Paris, Académie des Sciences:**
Comptes rendus hebdomadaires des séances. Tome 156, No. 23—Tome 158, No. 22.
(*Academy.*) 4to. Paris, 1913–1914

**Paris, Bureau des Longitudes:**
——: Annalès, Tome 9.
(*Bureau.*) 4to. Paris, 1913
——: Annuaire pour l'an 1914; avec des notices scientifiques.
(*Bureau.*) 16mo. Paris [1913]

Paris, Bureau des Longitudes—*continued*:

——: Connaissance des Temps, ou des mouvements célestes pour le méridien de Paris, à l'usage des astronomes et des navigateurs, 1915.
(*Bureau.*) 8vo. Paris, 1913

——: Connaissance des Temps. Extrait à l'usage des Écoles d'Hydrographie et des marins du commerce, 1914.
(*Bureau.*) 8vo. Paris, 1913

——: Réception des signaux radiotélégraphiques transmis par la Tour Eiffel. 2me édition.
(*Bureau.*) 8vo. Paris, 1913

Paris, Bureau International des Poids et Mesures:

——: Travaux et Mémoires. Tome 15.
(*Bureau.*) 4to. Paris, 1913

——: Procès-verbaux des séances [du comité] de 1913. 2me Série. Tome 7.
(*Bureau.*) 8vo. Paris, 1913

Paris, Congrès Astrophotographique International:

Bulletin du Comité International permanent pour l'exécution photographique de la carte du ciel. Tome 6, fasc. 1.
(*Paris Observatory.*) 4to. Paris, 1913

Paris, École Polytechnique:

Journal. Série 2, Cahier 17.
(*École Polytechnique.*) 4to. Paris, 1913

Paris, Ministère de l'Instruction Publique:

Enquêtes et documents relatifs à l'enseignement supérieur: Rapport sur les Observatoires astronomiques de province, Année 1912. CVII.
(*Minister of Public Instruction.*) 8vo. Paris, 1913

Paris, Ministère de la Marine:

Deuxième Expédition Antarctique Française (1908–1910), commandée par le Dr. Jean Charcot. Océanographie, Physique, &c.
(*Minister of Marine.*) 4to. Paris, 1913

Paris Observatoire:

——: Annales, . . . publiées sous la direction de B. Baillaud: Mémoires, Tome 31.
(*Observatory.*) 4to. Paris, 1913

A. Gaillot. Tables rectifées du mouvement de Jupiter.

——: Carte photographique du Ciel. Twenty-five charts. Zone $+24°$, $+22°$, $+20°$, $+18°$.
(*Minister of Public Instruction.*)

——: Rapport annuel sur l'état de l'Observatoire, 1913, par B. Baillaud.
(*Observatory.*) 4to. Paris, 1914

Paris, Société Astronomique de France:
L'Astronomie: Revue mensuelle d'astronomie, de météorologie et de physique du globe, et Bulletin de la Société Astronomique de France. Année 27, No. 7–12; Année 28, No. 1–6.
(*Society.*) 8vo. Paris, 1913–1914

Paris, Société Mathématique de France:
——: Bulletin. Tome 41, fasc. 2–4; Tome 42, fasc. 1.
(*Society.*) 8vo. Paris, 1913–1914
——: Comptes Rendus des Séances de 1913.
(*Society.*) 8vo. Paris, 1913

Paris, Société Philomathique:
Bulletin. 10me série. Tome 5, No. 1, 2.
(*Society.*) 8vo. Paris, 1913

Perth Observatory, Western Australia:
——: Bulletin. No. 1.
(*Observatory.*) 8vo. Perth, 1913
Catalogue of Double Stars.
——: Astrographic Catalogue, 1900·0. Perth Section, −31° to −41°. Vol. 2, 3.
(*Observatory.*) 8vo. Perth, 1912
Measures of Rectangular Co-ordinates.

Perth, Western Australian Astronomical Society:
Proceedings, Vol. 1.
(*Society.*) 8vo. Perth [1913]

Philadelphia, American Philosophical Society:
Proceedings. Vol. 52, No. 208–212.
(*Society.*) 8vo. Philadelphia, 1913–1914

Philadelphia, Franklin Institute:
Journal. Vol. 175, No. 6—Vol. 177, No. 5.
(*Institute.*) 8vo. Philadelphia, 1913–1914

Philadelphia, University of Pennsylvania:
Publications, Astronomical Series. Vol. 3, pt. 3.
(*University.*) 4to. Philadelphia, 1908
Results of observations with the . . . . Zenith Telescope of the Flower Observatory, 1904–1906.

Philosophical Magazine:
The London, Edinburgh, and Dublin Philosophical Magazine. Series 6, Vol. 26, 27 (No. 151–162).
(*Purchased.*) 8vo. London, 1913–1914

Pickering, Edward Charles:
*The Study of the Stars. Address of the President of the American Association for the Advancement of Science . . . 1913.
(*Author.*) 8vo. 1914

**Popular Astronomy.** Founded by W. W. Payne: edited by H. C. Wilson [and others]. Vol. 21, No. 7–12; Vol. 22, No. 1–6.
(*Editors.*) 8vo. Northfield, Minn., 1913–1914

**Potsdam, Astrophysikalisches Observatorium:**
——: Baubericht über die technischen Anlagen für das königliche astrophysikalische Observatorium auf dem Telegraphenberg bei Potsdam.
(*Lady Gill.*) fol. Berlin, 1879
——: Publicationen. Band 22, Stück 4–6; Band 23, Stück 1.
(*Observatory.*) 4to. Potsdam, 1913

Band 22, Stück 4. J. Wilsing. Helligkeitsverteilung im Sonnenspektrum.
,, 22, ,, 5. E. Kron. Schwärzungsgesetz photographischer Platten.
,, 22, ,, 6. R. Furuhjelm. Spektrum der Nova Geminorum No. 2.
,, 23, ,, 1. K. Schwarzschild. Bestimmung von Radialgeschwindigkeiten.

**Potsdam, Königl. preussisches Geodätisches Institut:**
Veröffentlichung, Neue Folge, No. 57–59.
(*The Institute.*) 4to and 8vo. Berlin, 1913–1914

No. 57. Jahresbericht des Direktors, 1912–1913.
,, 58. Seismometrische Beobachtungen in Potsdam, 1912.
,, 59. W. Schweydar. Lotstörungen durch Sonne und Mond.
L. Krüger. Transformation der Koordinaten bei konformen Doppelprojection des Erdellipsoids auf die Kugel und die Ebene.

**Potsdam, Zentralbureau der Internationalen Erdmessung:**
Veröffentlichungen, Neue Folge, No. 25.
(*The Bureau.*) 4to. Berlin, 1914

Bericht über die Tätigkeit des Zentralbureaus, 1913.

**Poughkeepsie, Vassar College Observatory:**
Publications. No. 3.
(*Observatory.*) 8vo. Poughkeepsie, 1913

Observations of Variable Stars, 1901–1912.

**Prague, K.K. Sternwarte:**
Magnetische und meteorologische Beobachtungen im Jahre 1912. Jahrgang 73.
(*Observatory.*) 4to. Prag, 1913

**Ptolemy (Claudius):**
Des Claudius Ptolemäus Handbuch der Astronomie . . . aus dem griechischen übersetzt und mit erklärenden Anmerkungen verschen, von Karl Manitius.
(*Purchased.*) 2 vols. 8vo. Leipzig, 1912–1913

**Pulkovo, Observatoire Central Nicolas:**
——: Jahresbericht [in Russian], 1912–1913.
(*Observatory.*) 8vo. St. Petersburg, 1913

Pulkovo, Observatoire Central Nicolas—*continued:*
——: Mittheilungen, Band 5, No. 6–12; Band 6, No. 1.
(*Observatory.*) 4to. St-Pétersbourg, 1913–1914
——: Publications . . . sous la direction de O. Backlund. Série 2. Vol. 17, No. 3; Vol. 18, No. 6; Vol. 20, 24.
(*Observatory.*) 4to. St-Pétersbourg, 1911–1913
——: Tables des quantités Besséliennes pour les années 1914–1915.
(*Observatory.*) 8vo. St-Pétersbourg, 1913

Rio de Janeiro, Observatorio:
Annuario . . . para o anno de 1914.
(*Observatory.*) 8vo. Rio de Janeiro, 1913

Rome, Reale Accademia dei Lincei:
Atti . . . Anno 310, 311, Serie quinta. Rendiconti, Classe di scienze fisiche, mathematiche e naturali. Vol. 22, semestre 1, fasc. 9–12; semestre 2, fasc. 1–12; Vol. 23, semestre 1, fasc. 1–8.
(*Academy.*) 4to. Roma, 1913–1914

Rome, Società Italiana delle Scienze:
Memorie di matematica e di fisica. Serie terza. Tomo 18.
(*Society.*) 4to. Roma, 1913

Rome, Specola Astronomica Vaticana:
Carta Fotografica del Cielo. Ten Charts. Zona + 55°.
(*Observatory.*)

San Fernando, Instituto y Observatorio de Marina:
——: Almanáque Náutico para el año 1915.
(*Observatory.*) 4to. San Fernando, 1913
——: Carta Fotografica del Cielo. (Forty charts.) Zone − 5°, − 7°.
(*Observatory.*)

San Francisco, Astronomical Society of the Pacific:
Publications, Vol. 25, 26 (No. 148–153).
(*Society.*) 8vo. San Francisco, 1913–1914

St. Petersburg, Académie Impériale des Sciences:
——: Bulletin, Série 6: 1913, No. 10–18; 1914, No. 1–9.
(*Academy.*) 4to. St-Pétersbourg, 1913–1914
——: Mémoires, Série 8: Tome 31, No. 2, 3.
(*Pulkovo Observatory.*) 4to. St-Pétersbourg, 1912

Schuster (Arthur):
*On the investigation of hidden periodicities with application to a supposed 26-day period of meteorological phenomena.
(*Author.*) 8vo. Cincinnati, 1898

Science Abstracts. Section A (Physics). Vol. 16, pt. 6–12; Vol. 17, pt. 1–5.
(*Institution of Electrical Engineers.*) 8vo. London, 1913–1914

**Scott (E. Erskine):**
Tables of logarithms and anti-logarithms to five places, with marginal indices for instant reference; to which is added a table for finding logarithms and anti-logarithms to ten places; and a table of constants, with formulæ for their application.
(*Lady Gill.*) 8vo. London, 1870

**See (T. J. J.):** Biography, etc., *see* **Webb.**

**Seeliger (Hugo):**
——: *Über die Abhängigkeit der Verteilung der Sterne von verschiedenen Spektraltypen und der mittleren Parallaxen der Sterne von galaktischen Breite.
(*Author.*) 4to. Kiel, 1912
——: *Uber die Verteilung der Sterne von verschiedenen Spektraltypen.
(*Author.*) 4to. Kiel, 1913

**Sirius.** Zeitschrift für populäre Astronomie; Redakteur H. J. Klein. Band 46, Heft 7–12; Band 47, Heft 1–6.
(*Editor.*) 8vo. Leipzig, 1913–1914

**South Kensington, Imperial College of Science and Technology:**
Calendar, session 1913–14.
(*College.*) 8vo. London, 1913

**South Kensington, Solar Physics Observatory:**
Report made to the Solar Physics Committee by Sir Norman Lockyer, 1912.
(*Observatory.*) 8vo. London, 1913

**Stockholm, Kongliga Svenska Vetenskaps Akademie:**
——: Arkiv för mathematik, astronomi och fysik. Bandet 8, Häfte 3, 4; Bandet 9, Häfte 1, 2.
(*Academy.*) 8vo. Uppsala & Stockholm, 1913
——: Årsbok för år 1913.
(*Academy.*) 8vo. Stockholm, 1913

**Stockholm, Observatorium:**
Astronomiska Iakttagelser och Undersökningar . . . utgivna af Karl Bohlin. Bandet 10, No. 2.
(*Observatory.*) 4to. Uppsala & Stockholm, 1913

**Stonyhurst College Observatory:**
Results of meteorological, magnetical, and seismological observations, with report and notes of the Director, Rev. W. Sidgreaves, 1913.
(*Observatory.*) 8vo. Clitheroe, 1914

**Stroobant (Paul):**
*Les progrès récents de l'Astronomie. (VI. Année 1912.)
(*Author.*) 8vo. Bruxelles, 1914

Struyck (Nicolaas):
Vervolg vande beschryving der Staartsterren, en nader ontdekkingen omtrent den Staat van't Menschelyk Geslagt, benevens eenige Sterrekundige, Aardrykskundige en andere aanmerkingen.
(*Lady Gill.*) 4to. Amsterdam, 1753

Sydney, Royal Society of New South Wales:
Journal and Proceedings. Vol. 46, pt. 1, 2; Vol. 47, pt. 1, 2.
(*Society.*) 8vo. Sydney, 1912–1913

Tacubaya, Observatorio Astronómico Nacional:
——: Anuario . . . para el año de 1914.
(*Observatory.*) 8vo. México, 1913
——: Boletin, No. 4.
(*Observatory.*) fol. México, 1914
——: Carta fotografica del cielo. Fifty charts. Zone $-11°$, $-13°$, $-15°$.
(*Observatory.*)

Tancock (E. O.):
The elements of descriptive Astronomy: a simple account of the celestial bodies and their motions.
(*Clarendon Press.*) 8vo. Oxford, 1913.

Tiflis, Physikalisches Observatorium:
Beobachtungen . . . im Jahre 1905.
(*Observatory.*) 4to. Tiflis, 1912

Toronto, Canadian Institute:
——: Transactions. Vol. 10, pt. 1.
(*Institute.*) 8vo. Toronto [1913]
——: Year Book and Annual Report for 1912–1913.
(*Institute.*) 8vo. Toronto [1913]

Toronto, Royal Astronomical Society of Canada:
——: Journal, Vol. 7, No. 1–6; Vol. 8, No. 1, 2.
(*Society.*) 8vo. Toronto, 1913–1914
——: The Observer's Handbook, 1914.
(*Society.*) 8vo. Toronto, 1914

Tortosa, Observatorio del Ebro:
Boletin mensual, Vol. 3, No. 9–12; Vol. 4, No. 1–8.
(*Observatory.*) 4to. Barcelona, 1913–1914

Toulouse, Académie des Sciences, Inscriptions et Belles-lettres:
Mémoires . . . 10me série. Tome 12.
(*Academy.*) 8vo. Toulouse, 1912

Toulouse, Observatoire Astronomique, Magnétique et Météorologique:
Carte photographique du Ciel: Sixteen charts. Zone $+9°$, $+7°$, $+5°$.
(*French Minister of Public Instruction.*)

Turin, Reale Accademia delle Scienze:
Atti, Vol. 48, No. 11–15; Vol. 49, No. 1–7.
(*Academy.*) 8vo. Torino, 1913–1914

Turin, Reale Osservatorio di Pino Torinese:
Annuario astronomico, pel 1914, 1915
(*Observatory.*) 8vo. Torino, 1914

Turin, Società Astronomica Italiana:
Revista di Astronomia e scienze affini. Anno 7, No. 6–12.
(*Society.*) 8vo. Torino, 1913

Turin, Società Urania:
Saggi di Astronomia Popolare, Anno 3, No. 7–12; Anno 4, No. 1–5.
(*Society.*) 8vo. Torino, 1913–1914

Turner (Herbert Hall):
Tables for facilitating the use of Harmonic Analysis.
(*Author.*) 8vo. London, 1913

Uccle, Observatoire Royal de Belgique:
——: Annales . . . Nouvelle série; Annales Astronomiques. Tome 14, No. 1.
(*Observatory.*) 4to. Bruxelles, 1913
——: Annuaire astronomique, 1914.
(*Observatory.*) 16mo. Bruxelles, 1913
——: Carte Photographique du Ciel. Eighty-one charts. Zone $+39^{\circ}$, $+37^{\circ}$, $+35^{\circ}$, $+33^{\circ}$.
(*Observatory.*)

United States Coast and Geodetic Survey:
——: Report of the Superintendent . . . showing the progress of the work during the year 1912–13.
(*Survey Office.*) 4to. Washington, 1913
——: Geodesy: Special Publications, No. 13–17.
(*Survey Office.*) 4to. Washington, 1913
No. 13. A. L. Baldwin. California-Washington Arc of primary triangulation.
,, 14. W. Bowie. Determination of time, longitude, and azimuth. 5th edition.
,, 15. R. L. Faris. Results of Magnetic observations, 1911–12.
,, 16. C. H. Swick. Triangulation along the West Coast of Florida.
,, 17. C. A. Mourhess. Triangulation on the Coast of Texas.
——: Results of observations made at the . . . Magnetic Observatory at Sitka, Alaska, 1911 and 1912.
(*Survey Office.*) 4to. Washington, 1914
——: Results of observations made at the . . . Magnetic Observatory near Honolulu, Hawaii, 1911 and 1912.
(*Survey Office.*) 4to. Washington, 1913
——: Results of observations made at the . . . Magnetic Observatory at Cheltenham, Maryland, 1911 and 1912.
(*Survey Office.*) 4to. Washington, 1913

Vienna, Kaiserliche Akademie der Wissenschaften:
——: Denkschriften . . . Mathematisch-naturwissenschaftliche Classe. Band 82, 88.
(*Academy.*) 4to. Wien, 1913–1914
——: Sitzungsberichte . . . Mathematisch-naturwissenschaftliche Classe. Abteilung II.a., Mathematik, Astronomie, Physik, Meteorologie, Mechanik. Band 121, Heft 9, 10; Band 122, Heft 1–8.
(*Academy.*) 8vo. Wien, 1912–1913

Virginia University, Leander McCormick Observatory:
*Publications . . . Vol. 2, pt. 2, 3.
(*Observatory.*) 8vo. Chicago, 1913–1914

Washington, National Academy of Sciences:
——: Memoirs, Vol. 11.
(*Academy.*) 4to. Washington, 1913
——: A history of the first half-century of the National Academy of Sciences, 1863–1913.
(*Academy.*) 4to. Washington, 1913

Washington, Smithsonian Institution:
——: Annual Report of the Board of Regents . . . 1912.
(*Institution.*) 8vo. Washington, 1913
——: Smithsonian Miscellaneous Collections. Vol. 57, No. 11–13; Vol. 59, No. 19; Vol. 60, No. 23, 30; Vol. 61, No. 1, 3–19, 21–25; Vol. 62, No. 1, 2; Vol. 63, No. 2–5; Vol. 64, No. 1.
(*Institution.*) 8vo. Washington, 1913–1914
——: Annals of the Astrophysical Observatory of the Smithsonian Institution. Vol. 3.
(*Institution.*) 4to. Washington, 1913
——: Report of the Astrophysical Observatory for the year ending June 30, 1913.
(*Institution.*) 8vo. Washington, 1914

Washington, United States Naval Observatory:
Report of the Superintendent . . . for the year 1913.
(*Observatory.*) 8vo. Washington, 1913

Webb (W. L.):
Brief biography and popular account of the unparalleled discoveries of T. J. J. See.
(*Author.*) 8vo. Lynn, Mass., 1913

Wolf (Max):
——: *Das Spektrum des Andromedanebels: Spektrum der Nova Geminorum, 1912: Über die Spektren einiger Spiralnebel: Nova Geminorum 2, im Frühjahr 1913: Die Spectra von vier Wolf-Rayet Sternen.
(*Author.*) 8vo. Heidelberg, 1912–1913

Wolf (Max)—*continued*:

——: *Der Einfluss kosmischen Probleme auf die Entwicklung der Spektralanalyse.
(*Author.*) 4to. Halle, 1913

Zeitschrift für Instrumentenkunde. Organ für Mittheilungen aus dem gesammten Gebiete der wissenschaftlichen Technik. Jahrgang 33, Heft 6–12; Jahrg. 34, Heft 1–5.
(*Purchased.*) 4to. Berlin, 1913–1914

Zürich, Naturforschende Gesellschaft:
Vierteljahrsschrift, Jahrgang 58, Heft 1–4.
(*Society.*) 8vo. Zürich, 1913–1914

Zürich, Sternwarte des Eidg. Polytechnikums:
Publikationen . . . Band 5. Herausgegeben von A. Wolfer.
(*Observatory.*) 4to. Zürich, 1913

## PHOTOGRAPHS, &c., PRESENTED TO THE SOCIETY.

Corney (B. G.).—Photograph of the Memorial erected on the site of Captain Cook's astronomical station in Tahiti (print).

Deslandres (Henri).—Spectroheliogram, taken at the Meudon Observatory (transparency).

D'Esterre (C. R.).—Photographs of the Orion Nebula, Nova No. 2, Persei, &c. (4 prints and 9 lantern slides).

Helwân Observatory.—Photographs of Nebulæ, made by Mr. H. Knox Shaw at the Khedivial Observatory (16 lantern slides).

Lady Huggins.—Portrait of Sir William Huggins, taken from the picture by the Hon. J. Collier.

Reynolds (J. H.).—Photograph of the spectrum of the Great Nebula in Orion (transparency).

Wolf (Max).—A series of photographs of Nebulæ and Spectra, and stereograms of Comet Morehouse, taken at the Heidelberg Observatory (15 transparencies).

# INDEX


PAGE

Acocks, H. F., Rev. T. E. R. Phillips and, Micrometrical measures of double stars in 1913 ..... 442
Adelaide Observatory, Report of the proceedings of the..... 316
Annual General Meeting, Report of the ..... 257
Armagh Observatory, Report of the proceedings of the ..... 293
Assets and present property of the Society..... 266
Associates proposed..... 551
Astrographic Chart and Catalogue, Council Note on the..... 353
Auditors of the Treasurer's accounts for 1913, appointed ..... 62
——————————————————— Report of the ..... 264

Baker, A. H., Obituary notice of ..... 268
Baker, H. F., Elected a Fellow..... 485
Ball, Sir Robert Stawell, Death of..... 268
Barlow, E. W., Note on the star 42 Virginis..... 707
Barrett, H. G. Scott, Note on the variable star VV (17. 1912) Aurigæ .. 538
Baxandall, F. E., On the occurrence of Europium lines in stellar spectra 32
——————————— On the enhanced lines of Manganese in the spectrum of α Andromedæ..... 250
Baxendell, J., Observations of variable stars, edited by H. H. Turner and M. A. Blagg: No. 2, R Boötis; No. 3, R Cancri; No. 4, R Coronæ; No. 5, S Coronæ, with correction to No. 1, R Arietis ..... 451
——————————— Observations of variable stars, edited by H. H. Turner and M. A. Blagg: Third instalment: No. 6, U Cygni; No. 7, R Delphini; No. 8, S Delphini; No. 9, T Delphini ..... 568
Bellamy, F. A., Sixth note on the number of faint stars with large proper motions: zone +29° ..... 26
Bevan, Penry Vaughan, Obituary notice of ..... 269
Bidlake, Rev. W., Elected a Fellow..... 485
Bigg-Wither, Archibald Cuthbert, Obituary notice of ..... 269
Bilt, Jan van der, Elected a Fellow..... 657
Blagg, Mary A., H. H. Turner and, Baxendell's observations of variable stars ..... 451, 568
Brown, E. W., The mean latitudes of the Moon and Sun ..... 156
——————————— The terms in the Moon's motion depending on the node. 392
——————————— The perigee and eccentricity of the Moon, 1750 to 1901. 396
——————————— Correction of errors in the new lunar theory ..... 424
——————————— The determination of the constants of the node, the inclination, the Earth's ellipticity, and the obliquity of the ecliptic from the Greenwich meridian observations of the Moon, 1847–1901 ..... 552
Buckland, S. H., Elected a Fellow ..... 155
Bulkeley, R. H., Elected a Fellow..... 258

Cambridge Observatory, Report of the proceedings of the..... 293
Cambridge University, Solar Physics Observatory, Report of the proceedings of the ..... 295
Candidates proposed ..... 1, 61, 515, 258, 391, 485, 657


*

PAGE

Cannon, Miss, elected an Honorary Member ..... 391
Cape of Good Hope, Royal Observatory, Report of the proceedings of the 288
Capon, R. S., Note on the spectroscopic binaries and the velocity of light 507
——————————————— Correction ..... 658
Carpenter, F. C. H., Elected a Fellow ..... 61
Chandler, Seth C., Death of ..... 268
Chapman, S., On the total light of the stars ..... 446
——————— and P. J. Melotte, Photographic magnitudes of 262 stars within 25′ of the north pole ..... 40
——————————— On the application of parallel wire diffraction gratings to photographic photometry ..... 50
**Comets:—**
Council note on comets in 1913 ..... 325
Cooke, F. B., Elected a Fellow ..... 657
Cortie, Rev. A. L., An area of long-continued solar disturbance and the associated magnetic storms ..... 670
Crawford, The Earl of, Obituary notice of ..... 271
Cullen, R. T., Elected a Fellow ..... 258
Cushing, Thomas, Obituary notice of ..... 273
Curtis, W. E., Elected a Fellow ..... 551

Dale, J. B., The resolution of a compound periodic function into simple periodic functions ..... 628
——————— Note on the number of components of a compound periodic function ..... 664
——————— The fluctuations in the epochs of sun-spot maxima and minima ..... 664
D'Esterre, C. R., Report of his Observatory ..... 307
——————————— Observations of the region of Nova No. 2 Persei ..... 534
Denning, W. F., Reply to his "Observations of the Orionids," C. P. Olivier ..... 37
——————————— Errata in his paper "Observations of the Orionids" .. 59
Diffraction gratings, parallel wire, On the application of, to photographic photometry, S. Chapman and P. J. Melotte ..... 50
Dome shutters, Note on a method of balancing, W. H. Maw ..... 2
Dunsink Observatory, Report of the proceedings of the ..... 298
——————————— Three variable stars in the region of $\chi$ Persei ..... 686
Durham University Observatory, Report of the proceedings of the ..... 298
Dyson, F. W., The proper motions of the stars in Carrington's Circumpolar Catalogue in relation to their spectral types ..... 733

Eckersley, T. L., Elected a Fellow ..... 485
Eddie, Lindsay Atkins, Obituary notice of ..... 274
Eddington, A. S., The dynamics of a globular stellar system ..... 5
Edinburgh, Royal Observatory, Report of the proceedings of the ..... 291
Errata ..... 59, 549, 731
Espin, Rev. T. E., Micrometrical measures of double stars (tenth series), and new double stars ..... 244
——————————— Report of his Observatory (Wolsingham) ..... 307
Evans, Rev. Charles, Elected a Fellow ..... 155

Fellows elected ..... 1, 61, 155, 258, 391, 485, 551, 657
Fisher, R. A., Elected a Fellow ..... 391
Fletcher, J. S., Elected a Fellow ..... 391
Franks, W. S., Micrometrical measures of 360 wide double stars ..... 517
——————————————————————————— Errata. 731
——————— The double star OΣ 137 ..... 655
Franz, Julius Heinrich G., Obituary notice of ..... 281

Galactic co-ordinates, O. R. Walkey ..... 201
Gheury, M. E. J., and N. E. Robertson, Occultation results, 1912 and 1913 ..... 540

PAGE

Gibb, David, The periodogram analysis of the variations of SS Cygni ... 678
Gifts to the general funds of the Society ... 264
Gilchrist, Capt. W. G. W., Elected a Fellow ... 485
Gill, Sir David, Death of: resolution of Council ... 259
Glasgow Observatory, Report of the proceedings of the ... 299
Glauert, Hermann, Elected a Fellow ... 515
**Gold Medal** of the Society, awarded to Prof. Max Wolf for his work in celestial photography ... 257, 267, 371
Gray, Maj.-Gen. W. du G., Elected a Fellow ... 557
Greenwich, Royal Observatory, Results of micrometer measures of double stars made with the 28-inch refractor in the year 1912 ... 137
——————— Report of the proceedings of the ... 285
——————— Observations of occultations of Stars by the Moon made in the year 1913 ... 445
Guild, John, Elected a Fellow ... 391

Halm, J., A system of photographic magnitudes for southern stars ... 600
Hardcastle, J. A., Nebulæ seen on Mr. Franklin-Adams' plates: with note by A. R. Hinks ... 699
Hart, I. B., Elected a Fellow ... 485
Hartley, W. E., Elected a Fellow ... 155
Helwân, Khedivial Observatory, Report of the proceedings of the ... 311
Henkel, Frederick William, Obituary notice of ... 274
Hepburn, P. H., Dimensions of Saturn and his rings, as measured on Prof. Barnard's photograph of 1911 Nov. 19: Observations on the transparency of ring A, and other details appearing on the photograph ... 721
Hill Observatory, Salcombe Regis, Report of the proceedings of the ... 305
Hills, E. H., Address on presenting the Gold Medal of the Society to Prof. Max Wolf ... 377
Hinks, A. R., Note on Mr. Hardcastle's paper on the nebulæ on the Franklin-Adams plates ... 706
Honorary Member, Announcement of election of Miss Annie J. Cannon 391
Horsefield, D. F., Elected a Fellow ... 61
Hussain, Ahmed, Elected a Fellow ... 551

Innes, R. T. A., The magnitude of $\eta$ Argûs, 1914, and the discovery of a close companion to it ... 697

Jackson, J., Retrograde satellite orbits ... 62
Jarry-Desloges, R., Elected a Fellow ... 258
Jeans, J. H., On the "kinetic theory" of star-clusters ... 109
Johannesburg, Union Observatory, Report of the proceedings of the ... 320
Jones, H. S., Elected a Fellow ... 61
——————— The proper motions of the brighter stars within 17° of the pole, considered in relation to their spectral type ... 168
Jones, R. L., Elected a Fellow ... 155
Jupiter, The equatorial current of, in 1913, Rev. T. E. R. Phillips ... 116

Killip, Robert, Obituary notice of ... 275
Kodaikânal and Madras Observatories, Report of the proceedings of the. 315

Laing, Rev. Thomas, Elected a Fellow ... 551
Latitude variation, Council note on ... 369
Leale, Thomas Henry, Obituary notice of ... 275
Ledger, Edmund, Obituary notice of ... 276
Liapin, Nicolas, Elected a Fellow ... 1
**Library** of the Royal Astronomical Society, List of donors to the ... 372
**Light, velocity of**: Note on spectroscopic binaries and the velocity of light, R. S. Capon ... 507
——————— Correction ... 658

PAGE

**Light, velocity of:** Plummer, H. G., Note on the velocity of light and Doppler's principle ..... 660
Liverpool Observatory, Report of the proceedings of the ..... 299
Lunar Theory, *see* Moon.
Lyons, Capt. H. G., Elected a Fellow..... 155

McCarthy, Jonadab, Obituary notice of..... 276
Martin, C., H. C. Plummer and, On the short period variable, XZ Cygni ..... 225
Maunder, E. W., Distribution of sun-spots in heliographic latitude, 1874–1913..... 112
Maw, W. H., Note on a method of balancing dome shutters ..... 2
Melbourne Observatory, Report of the proceedings of the ..... 482
Melotte, P. J., S. Chapman and, Photographic magnitudes of 262 stars within 25′ of the north pole ..... 40
——————————— On the application of parallel wire diffraction gratings to photographic photometry..... 50
**Meteors:** Reply to Mr. Denning's "Observations of the Orionids," C. P. Olivier..... 37
**Minor Planets,** Council note on the discovery of, in 1913 ..... 323
**Moon, Occultations of stars by the,** observed at the Royal Observatory, Greenwich, in the year 1913..... 445
——————————— Occultation results, 1912 and 1913, M. E. J. Gheury and N. E. Robertson ..... 540
**Moon, Theory and tables of the:** The mean latitudes of the Moon and Sun, E. W. Brown ..... 156
——————————— The terms in the Moon's motion depending on the node, E. W. Brown..... 392
——————————— The perigee and eccentricity of the Moon, 1750 to 1901, E. W. Brown ..... 396
——————————— Correction of errors in the new lunar theory, E. W. Brown ..... 424
——————————— The determination of the constants of the node, the inclination, the Earth's ellipticity, and the obliquity of the ecliptic from the Greenwich meridian observations of the Moon, 1847–1901, E. W. Brown ..... 552

**Nebulæ and Clusters:—**
The dynamics of a gobular stellar system, A. S. Eddington..... 5
On the "kinetic theory" of star-clusters, J. H. Jeans..... 109
The light curve of the Andromeda nebula (N.G.C. 224), J. H. Reynolds ..... 132
Hydrogen and the primary constituents of nebulæ, J. W. Nicholson.....
The nebula H.IV.69 Tauri, N.G.C. 1514, and the fainter nebulæ N.G.C. 821, 2655, 2782, 2787, 2830, 2859, 2880, Mrs. Isaac Roberts..... 234
The constitution of nebulæ, J. W. Nicholson..... 486
On the nebular line λ 3729, J. W. Nicholson ..... 623
Nebulæ seen on Mr. Franklin Adams' plates, J. A. Hardcastle, with note by A. R. Hinks..... 699
The nebula H.V.25 Ceti, Mrs. Isaac Roberts..... 712
Newbegin, G. J., Report of his Observatory ..... 309
Nicholson, J. W., The spectra of Wolf-Rayet stars..... 118
——————————— Hydrogen and the primary constituents of nebulæ ... 204
——————————— The spectra of hydrogen and helium ..... 425
——————————— The constitution of nebulæ ..... 486
——————————— On the nebular line λ 3729..... 623

**Obituary Notices: Associates:—**
Franz, Julius Heinrich G. ..... 281
Scheiner, Julius..... 282

PAGE

**Obituary Notices: Fellows:—**
Baker, Arthur Henry ..... 268
Bevan, Penry Vaughan ..... 269
Bigg-Wither, Archibald Cuthbert ..... 269
Crawford, Earl of ..... 271
Cushing, Thomas ..... 273
Eddie, Lindsay Atkins ..... 274
Henkel, Frederick William ..... 274
Killip, Robert ..... 275
Leale, Thomas Henry ..... 275
Ledger, Edmund ..... 276
McCarthy, Jonadab ..... 276
Ristenpart, Friedrich Wilhelm ..... 276
Smart, David ..... 278
Terry, Thomas Robert ..... 279
Tyer, Edward ..... 280
White, Edward John ..... 280
Williams, Hugh ..... 281
**Observatories,** Work at various: see the reports of individual Observatories (or observers) under their respective headings.
O'Connor, Rev. Edward, Elected a Fellow ..... 155
Officers and Council, List of, 1914–1915 ..... 390
Olivier, C. P., Reply to Mr. Denning's "Observations of the Orionids" ..... 37
——— Elected a Fellow ..... 391
Ottawa, Dominion Observatory, Report of the proceedings of the ..... 312
Oxford, Radcliffe Observatory, Report of the proceedings of the ..... 300
——— University Observatory, Report of the proceedings of the ..... 302

Paisley, Coats Observatory, Report of the proceedings of the ..... 304
Peek, Sir Wilfrid, Report of his Observatory (Rousdon) ..... 309
Periodic Function, Resolution of a compound into simple periodic functions, J. B. Dale ..... 628
——— Compound, Note on the number of components of a, J. B. Dale ..... 664
Perth Observatory, Western Australia, Report of the proceedings of the 317
Phillips, Rev. T. E. R., The equatorial current of Jupiter in 1913 ..... 116
——— Report of his Observatory ..... 310
——— and H. F. Acocks, Micrometrical measures of double stars in 1913 ..... 442
Plummer, H. G., Note on the velocity of light and Doppler's principle .. 660
——— C. Martin and, On the short period variable XZ Cygni 225
Pocock, R. J., Seventh note on the number of faint stars with large proper notions: some A.G.C. stars in zone +25° ..... 27
——— Elected a Fellow ..... 258
Powell, Legh Richmond, Death of ..... 268
Presents announced ..... 2, 62, 156, 392, 486, 552, 657
Progress and present state of the Society ..... 260
Publications of the Society ..... 267

Report of the Council to the ninety-fourth Annual General Meeting of the Society ..... 260
Reynolds, J. H., The light curve of the Andromeda Nebula (N.G.C. 224) 132
——— Report of his Observatory ..... 310
Ridsdale, Rev. A. C., Elected a Fellow ..... 551
Ristenpart, Friedrich Wilhelm, Obituary notice of ..... 276
Roberts, A. W., Report of his Observatory (Lovedale, S. Africa) ..... 322
Roberts, Mrs. Isaac, The nebula H.IV. 69 Tauri, N.G.C. 1514, and the fainter nebulæ N.G.C. 821, 2655, 2782, 2787, 2830, 2859, 2880 234
——— The nebula H.V. 25 Ceti ..... 712
Robertson, N. E., M. E. J. Gheury and, Occultation results, 1912 and 1913 ..... 540

PAGE

Robins, H. G., Elected a Fellow ..... 61
Robinson, Charles, Elected a Fellow ..... 551
Rugby, Temple Observatory, Report of the proceedings of the ..... 304

Sampson, R. A., Note on the method of reduction of the Paris wireless rhythmic signals ..... 545
Sargent, Frank, Elected a Fellow ..... 551
Satellite orbits, Retrograde, J. Jackson ..... 62
**Saturn**, Dimensions of Saturn and his rings, as measured on Prof. Barnard's photograph of 1911, Nov. 19; Observations on the transparency of ring A, and other details appearing on the photograph, P. H. Hepburn ..... 721
Scheiner, Julius, Obituary notice of ..... 282
Smart, David, Obituary notice of ..... 278
South Kensington, Royal College of Science Observatory, Report of the proceedings of the ..... 304
Spectra, Series lines in, Council note on ..... 354
Spectra of hydrogen and helium, The, J. W. Nicholson ..... 425
Star 42 Virginis, note on the, E. W. Barlow ..... 707
**Star Catalogues**: Council note on the Astrographic Chart and Catalogue 353
**Stars, Distribution and drift of,** Council note on ..... 345
——— ——— Council note on "the plan of selected areas" ..... 348
**Stars, Double and multiple,** Results of micrometer measures of double stars made with the 28-inch refractor at the Royal Observatory, Greenwich, in the year 1912 ..... 137
——— Micrometrical measures of double stars, (tenth series) and new double stars, Rev. T. E. Espin ..... 244
——— Council note on, 1913 ..... 339
——— Erratum ..... 549
——— Micrometrical measures of double stars in 1913, Rev. T. E. R. Phillips and H. F. Acocks ..... 442
——— Note on spectroscopic binaries and the velocity of light, R. S. Capon ..... 507
——— Correction ..... 658
——— Micrometrical measures of 360 wide double stars, W. S. Franks ..... 517
——— Errata ..... 731
——— The double star OΣ 137, W. S. Franks ..... 655
**Stars, Galactic co-ordinates of,** O. R. Walkey ..... 201
**Stars, Magnitudes of,** Photographic magnitudes of 262 stars within 25′ of the north pole, S. Chapman and P. J. Melotte ..... 40
——— On the application of parallel wire diffraction gratings to photographic photometry, S. Chapman and P. J. Melotte ..... 50
——— A system of photographic magnitudes for southern stars, J. Halm ..... 600
**Stars, Motions and distances,** Sixth note on the number of faint stars with large proper motions, zone +29°, F. A. Bellamy ..... 26
——— Seventh note on the number of faint stars with large proper motions; some A.G.C. stars in zone +25°, R. J. Pocock ..... 27
——— The proper motions of the brighter stars within 17° of the pole, considered in relation to their spectral type, H. S. Jones ..... 168
——— The proper motions of the stars in Carrington's circumpolar catalogue in relation to their spectral type, F. W. Dyson ..... 733
**Stars, Spectra of,** On the occurrence of Europium lines in stellar spectra, F. E. Baxandall ..... 32
——— The spectra of Wolf-Rayet stars, J. W. Nicholson ..... 118

PAGE

**Stars, Spectra of,** Proper motions of the brighter stars considered in relation to their spectral type, H. S. Jones ..... 168
———— On the enhanced lines of Manganese in the spectrum of α Andromedæ, F. E. Baxandall ..... 250
———— Council note on stellar spectroscopy in 1913 ..... 361
**Stars, Temporary:** Nova No. 2 Persei, Observations of the region of, C. R. D'Esterre ..... 534
**Stars, Total light of the,** S. Chapman ..... 446
**Stars, Variable:—**
On a new Algol-type variable star in Pegasus, A. S. Williams ..... 215
On the short period variable XZ Cygni, C. Martin and H. C. Plummer ..... 225
Council note on, 1913 ..... 341
Baxendell's observations of variable stars, edited by H. H. Turner and M. A. Blagg: No. 2, R Boötis; No. 3, R Cancri; No. 4, R Coronæ; No. 5, S Coronæ: with correction to No. 1, R Arietis ..... 451
VV (17. 1912) Aurigæ, Note on, H. G. Scott Barrett ..... 538
Baxendell's observations of variable stars, edited by H. H. Turner and M. A. Blagg: No. 6, U Cygni; No. 7, R Delphini; No. 8, S Delphini; No. 9, T Delphini ..... 568
SS Cygni: the periodogram analysis of the variations of, D. Gibb.. 678
Three variable stars in the region of χ Persei, Dunsink Observatory 686
η Argûs, Magnitude of, in 1914, and the discovery of a close companion to it, R. T. A. Innes ..... 697
Discovery of a variable star in Carina, H. E. Wood ..... 698
Stellar system, The dynamics of a globular, A. S. Eddington ..... 5
Stonyhurst College Observatory, Report of the proceedings of the ..... 306
**Sun, Chromosphere and prominences:—**
Council note on solar activity in 1913 ..... 330
———— on solar research in 1913 ..... 331
**Sun, Place of the,** within the star-sphere, O. R. Walkey ..... 649
**Sun, Radiation:** Council notes on solar radiation ..... 333, 337
**Sun-Spots and Faculæ:** Further remarks on the expression of sun-spot periodicity as a Fourier sequence, H. H. Turner ..... 16
———— On a simple method of detecting discontinuities in a series of recorded observations, with an application to sun-spots, suggesting that they are caused by a meteor swarm, H. H. Turner ..... 82
———— Distribution of sun-spots in heliographic latitude, 1874–1913, E. W. Maunder ..... 112
———— Council note on solar activity in 1913 ..... 330
———— on solar research in 1913 ..... 331
———— The fluctuations in the epochs of sun-spot maxima and minima, J. B. Dale ..... 664
**Sun-Spots and Terrestrial Magnetism:** An area of long-continued solar disturbance and the associated magnetic storms, Rev. A. L. Cortie ..... 670
Swift, Lewis, Death of ..... 268
Sydney Observatory, Report of the proceedings of the ..... 319

Terry, Thomas Robert, Obituary notice of ..... 279
Thow, William, Elected a Fellow ..... 258
Toy, H. S., Elected a Fellow ..... 155
Treasurer's account for 1913 ..... 262
Trust Funds ..... 265
Turner, H. H., Further remarks on the expression of sun-spot periodicity as a Fourier sequence (Papers of the I.U.S.R. Computing Bureau, No. XII.) ..... 16
———— On a simple method of detecting discontinuities in a series of recorded observations, with an application to sun-spots, suggesting that they are caused by a meteor swarm due

PAGE

to successive encounters of the Leonids with Saturn, which has been more than once considerably perturbed by the Leonid swarm (Papers of the I.U.S.R. Computing Bureau, No. XIII.) 82
Turner, H. H., M. A. Blagg and, Baxendell's observations of variable stars ..... 451, 568
Tyer, Edward, Obituary notice of..... 280

Walkey, O. R., Galactic co-ordinates ..... 201
——————— The Sun's place within the star-sphere..... 649
Walsham, Hugh, Elected a Fellow..... 485
Warren, L. A. H., Elected a Fellow ..... 258
White, Edward John, Obituary notice of..... 280
Williams, A. Stanley, On a new Algol-type variable star in Pegasus..... 215
——————— Hugh, Obituary notice of ..... 281
Wireless telegraphy, Council note on astronomy and ..... 368
——————————— Note on the method of reduction of the Paris wireless rhythmic signals, R. A. Sampson..... 545
Witchell, W. M., Elected a Fellow ..... 258
Wolf, Max, The Gold Medal of the Society presented to him for his work in celestial photography and spectroscopy.....257, 267, 377
Wood, H. E., Discovery of a variable star in Carina..... 698
Wright, C. S., Elected a Fellow ..... 485

# MONTHLY NOTICES

OF THE

# ROYAL ASTRONOMICAL SOCIETY.

VOL. LXXIV. No. 1. NOVEMBER 1913.

PUBLISHED BY THE ROYAL ASTRONOMICAL SOCIETY,

AND SOLD BY

WILLIAM WESLEY & SON, 28 ESSEX STREET,

STRAND, LONDON, W.C.

PRICE TO NON-FELLOWS, 2*s.* 6*d.*

## ANNOUNCEMENT OF PAPERS RECEIVED.

Post-cards, giving the titles of such Papers as have been received or promised up to the Tuesday preceding the day of the Ordinary Meeting, will be sent to those Fellows who inform the Assistant Secretary of their wish to receive them.

---

## NOTICE TO AUTHORS.

Diagrams or other illustrations accompanying Papers should be sent in a state suitable for direct photographic reproduction. It is preferable that diagrams should be drawn on a larger scale than required, in Indian ink on white paper, all lines, etc., being sufficiently bold to bear the reduction required.

If drawn on squared paper, it is important that the squares should be in *blue* (not yellow) ink, unless it is desired that all the squares should be reproduced.

It is better to write the lettering in pencil, that it may be re-drawn to the proper scale.

## CONTENTS.


| | PAGE |
|---|---|
| Fellow elected | 1 |
| Candidates proposed | *ib.* |
| Presents announced | 2 |
| **W. H. Maw**, Note on a method of balancing Dome Shutters | *ib.* |
| **A. S. Eddington**, The Dynamics of a globular Stellar System | 5 |
| **H. H. Turner**, Further remarks on the expression of Sun-spot Periodicity as a Fourier Sequence. (Papers of the I.U.S.R. Computing Bureau, No. XII.) | 16 |
| **F. A. Bellamy**, Sixth note on the number of Faint Stars with large Proper Motions. Zone + 29° | 26 |
| **R. J. Pocock**, Seventh note on the number of Faint Stars with large Proper Motions. Some A.G.C. Stars in Zone + 25° | 27 |
| **F. E. Baxandall**, On the occurrence of Europium lines in Stellar Spectra | 32 |
| **C. P. Olivier**, Reply to Mr. Denning's "Observations of the Orionids" | 37 |
| **S. Chapman** and **P. J. Melotte**, Photographic magnitudes of 262 stars within 25′ of the north pole | 40 |
| **S. Chapman** and **P. J. Melotte**, On the application of Parallel wire diffraction gratings to photographic Photometry | 50 |
| Errata | 59 |


Printed by NEILL & Co., LTD., Bellevue. Edinburgh, December 1913.